cycles

—A MONTHLY REPORT

March 1953

FOUNDATION FOR THE STUDY OF CYCLES
New York, New York

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cycles
—a monthly report

The Official Bulletin of the Foundation for the Study of Cycles

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The Director's Letter

Dear Member:

Wasn't it George Bernard Shaw who said, speaking of the rendition of a difficult aria by a very poor singer, "It is not a question of how well she did it. Like a dog climbing a ladder, the marvel is that she could do it at all."

The First Photograph

In **Life** a few months ago there was published a copy of the very first photograph ever made. It was supposed to be a picture of a man and a wall and a tree. To me it looked pretty much like a blob. Even so, wasn't it marvelous that anything came out?

As I view my own cycle work and the cycle work of others, I often think of Shaw's remark and of the first photograph. When you stop to think of it, isn't it remarkable that one can take the figures for past performances of something, put these figures in a hat as it were, go through some kind of statistical hocus-pocus, and shake the figures out onto the table in such a way as to bear even the remotest resemblance to the future?

For millions of years man has been trying to foresee the future. In the study of cycles he has hit upon a scheme that offers hope of at least partial success in this direction. Cycle students should be expected to fail. But their more than occasional successes should encourage them to pick themselves up and try again.

Maxwell House Coffee

Cycle studies remind me of the story about Maxwell House coffee.

It seems that a report came to the New York headquarters of the Maxwell House company that there was a man in Georgia who drank a hundred cups of their coffee a day. Naturally they pricked up their ears and sent a man to investigate.

On arriving at the farm in question the investigator found a typical Georgia cracker establishment,—hound dog asleep in the front yard, man asleep on the front porch.

Waking the man the investigator said, "We hear that you drink 100 cups of Maxwell House a day. Is this true?"

"Yes," said the man.

"Doesn't it keep you awake?"

"No," said the man, "but it helps!"

Cycle analysis too, like the coffee of the Georgia cracker, will help—if you take enough of it.

The PREDIX Charts

In this report I am printing for you the first of three charts showing repetitive cycles in the stock market as determined by Mr. Vedder Hughey of Coral Gables, Florida and published early in 1951 under the pseudonym of "Predix." This chart shows the long-term cycles as determined at that time by Mr. Hughey.

The chart to be published next month shows his cycles of medium length, as determined early in 1951.

The month after that I plan to print for you his short-term cycles and the synthesis of all the cycles, as determined early in 1952.

Mr. Hughey has done some additional work in this field since that time. You will find reference to this supplemental work in an advertisement on the back cover.

Now let us get some things straight about these projections, their strengths,—and their weaknesses.

A Competent Job

First of all, I have every reason to believe that Mr. Hughey has done an honest and a competent job. There is no secrecy about any of his work. His methods are fully revealed. Any competent person could duplicate his work and, presumably, obtain the same answers.

I will go further than that. I will say that in the present limited state of our knowledge about cycles, I do not think anyone could have done a better job, **for the time and money spent**. With more time and more money the job could doubtless be improved considerably.

Limitations

On the other hand, as Mr. Hughey would be the first to tell you, his work—like **all** cycle work until we know much more—is subject to many limitations. More particularly—

1. The data with which he had to work were not homogeneous.

2. Some of the cycles found by Hughey may have been cycles present in the original series purely by accident. Such cycles have no significance whatever and of course will not continue.

3. Hughey almost certainly has missed some of the cycles really present.

4. Hughey may not, in all instances, have determined the timing, shape, strength, and lengths of the component cycles with sufficient accuracy. It is particularly important that cycle length be determined with the greatest accuracy.

For example, if there should be a cyclic force influencing stock market prices with a period or length of 3.045 months and Hughey determined this length to be 3.050 months, the first month his cycle will be out of step with reality by .005 months. In ten cycles it will be out of step about .05 months. In 100 cycles (300 months or 25 years) it will be out of step .5 months. In 200 cycles (600 months) it will be out of step one month, or a third of a cycle.

Assuming he has fitted his 3.050-month cycle as well as may be to the entire series of 1176 months the fit will be pretty good in the middle but about a month out at the ends—just where you want to use it. This is going to reduce the accuracy of the forecast.

5. In some instances Hughey may have discovered cyclic behavior which is the result of cyclic causes closely related to each other in time span. Cycles caused in this way fade out and reappear upside down. Obviously such cycles included in a projection right side up will introduce an error when the "false" cycle fades out and reverses.

Some Long Cycles May Not Be Real

6. Hughey isolated a number of long cycles which have not repeated themselves often enough to justify any assumptions in regard to their reality. By including the long cycles he was able to make his synthesis fit the behavior from 1854 to date much more closely than it would otherwise have done. Fitting the over-all curve more closely helps you to compare the shorter moves more easily, and is thus justified. However the projection of these long cycles is of no significance until we can learn, from the study of long series of tree ring figures or otherwise, that cycles of these longer lengths really do exist.

7. Finally, even if the cycle analysis had been made by an omniscient Being, and could be counted upon to be correct in every particular, we would still not expect it to be more than a partial forecast of the future. Cyclic forces cannot possibly account for **all** the ups and downs of the market. Sporadic accidental factors have their influence too. The most we can hope from a cycle analysis is that it will throw **some** light on the future and that it will be more right than wrong.

Forecast Has Worked

For all these reasons I do not feel that, until it has proved itself, Hughey's forecast is necessarily good enough for a prudent man to follow in the purchase and sale of stocks,—nor, incidentally, do I consider the forecast of anybody else good enough, either. However, I am **much** encouraged by the way in which the market in general has conformed for the last ten months to Hughey's projection made last April. If it continues to work, we can and should place more and more reliance upon it. Moreover in the meantime we can and should improve it. This I am trying to do by means of intensive studies of particular cycles, and so is Mr. Hughey.

The fact that Hughey's projection of stock market cycles made in 1951 and my projection of stock market cycles made in 1944 do not agree may bother you. Lest it bothers you I had best repeat some remarks on this subject made in my report for April 1952:

"I want to answer several requests asking me to explain why my stock market projection and Mr. Hughey's projection differ.

The Dewey vs. the Predix Projections

In referring to the Dewey vs. the Hughey projection, I have in mind, of course, a synthesis which I published in the June 1951 and September 1951 reports and a similar synthesis published by Mr. Vedder Hughey of Coral Gables, Florida, under the pseudonym of Predix.

One important difference between Hughey's projection and mine is the fact that Hughey's synthesis includes two important short-term cycles, both of which he diagrams as going down at the present time, whereas my synthesis contained no cycles less than 4.89 years in length.

Mr. Hughey's synthesis does not contradict mine; it supplements it.

Let me give you an analogy. Suppose I had made a reconnaissance survey of the height of the land above sea level, starting at New York and going westward. I might have discovered that for the first 50 miles the land averaged 50 feet above sea level, that for the next 50 miles it averaged 300 feet above sea level, and so on. This broad picture might be quite correct, but a more detailed survey would show wide variations from the averages. The hills would rise way above the average; the valleys would dip way beneath it.

This analogy applies to the surveys of market cycles made by Hughey and by me. Using only the longer cycles, my synthesis could not possibly be right for short-term moves. It was not designed to be.

A second difference between the two jobs is that mine was strictly preliminary and made for purposes of general reconnaissance only. My job took me only about three months to complete. Hughey, on the other hand, attempted to do a finished job. It took him about two year's time and, in addition, he had the aid of extensive IBM machine calculations.

I have explained time and again that my synthesis was merely a preliminary "mock-up" of some cycles which might be present in the stock market and that it was not to be relied upon as a forecast. In fact, I went further and said that the chart was printed "chiefly to show that these other cycles, if they exist, [and I put "if they exist" in bold face type] could badly distort the low of the 9.2-year cycle," which was described in detail in the June 1951 issue.

The ideal 9.2-year cycle is going up at the present time. Thus, if you knew only about the 9.2-year cycle you would be bullish. To counteract any such impression, I published an old synthesis which I had made some years before which showed that other cycles could completely wipe out the effect of the 9.2-year cycle, and might very easily do so in the present instance.

A third difference between Mr. Hughey's work and mine is that in his synthesis he used 19 cycles, whereas I used but 10.

This inclusion of other cycles is bound to make a difference in the projection and would, of course, make Hughey's projection better than mine if the additional cycles are real and continue.

Hughey's synthesis should be better than mine but, as I have said before, neither projection is good enough for a prudent man to follow. Hughey's forecast is, however, worthy of the most serious attention of cycle students because, in my opinion, it is the best job along these lines that has been done to date.

PREDIX Forecast Improved

The above quotation was written after the publication of the first of the three charts referred to above. Since that time the two additional charts, incorporating the results of Mr. Hughey's research in respect to medium and short-term cycles, have been added to the synthesis. These provide a better fit to past behavior and, everybody hopes, will provide a better forecast as well.

It may be said in passing that these hopes have been abundantly fulfilled, at least from April 1952 to date of writing. You will be able to see this for yourself when, in April and May respectively, we publish Mr. Hughey's medium and short-length cycles and his revised synthesis, including these additional cycles.

● ● ●

Technical

It is a real pleasure to print in the technical section of this issue an article by Mr. Hughey describing more fully than ever before the techniques used in the Predix analysis.

● ● ●

The Six-Year Cycle

I want very much to show you how the six-year cycle has worked out through 1952 in the sales or production or revenue of various large industrial concerns. However, figures for 1952 are not available as we go to press, and it seems silly, in a report which will reach you mid-March 1953, to limit the extension to 1951.

Figures for 1952 should, in all instances, be available in a month or two. When we have them we will bring up to date the work done in 1949 and published in 1950 which projected into the future the six-year cycle as found in these various series of figures. It is remarkable that one single cycle so fully accounts for the fluctuations of so many different companies.

Cordially yours,

Edward R. Dewey

Director

Technical

PREDIX TECHNIQUES

by VEDDER HUGHEY

BY way of illustrating the effect of applying our analytical devices to the data of a time series, we have drawn up some amplitude charts, shown on subsequent pages. These amplitude charts show the percentage of any amplitude that may have been present in the data which remain after the indicated manipulation of the data. We call these graphs "other amplitudes present" curves, abbreviated as O.A.P. curves.

The object of the analysis is to so treat the data as to reveal a suspected cycle of a certain length by suppressing cycles of all other lengths, in so far as possible. We can never do this perfectly with a series of limited length and containing some random fluctuation which is not cyclical. But with a series of considerable length we can do a pretty good job by applying four quite simple successive operations.

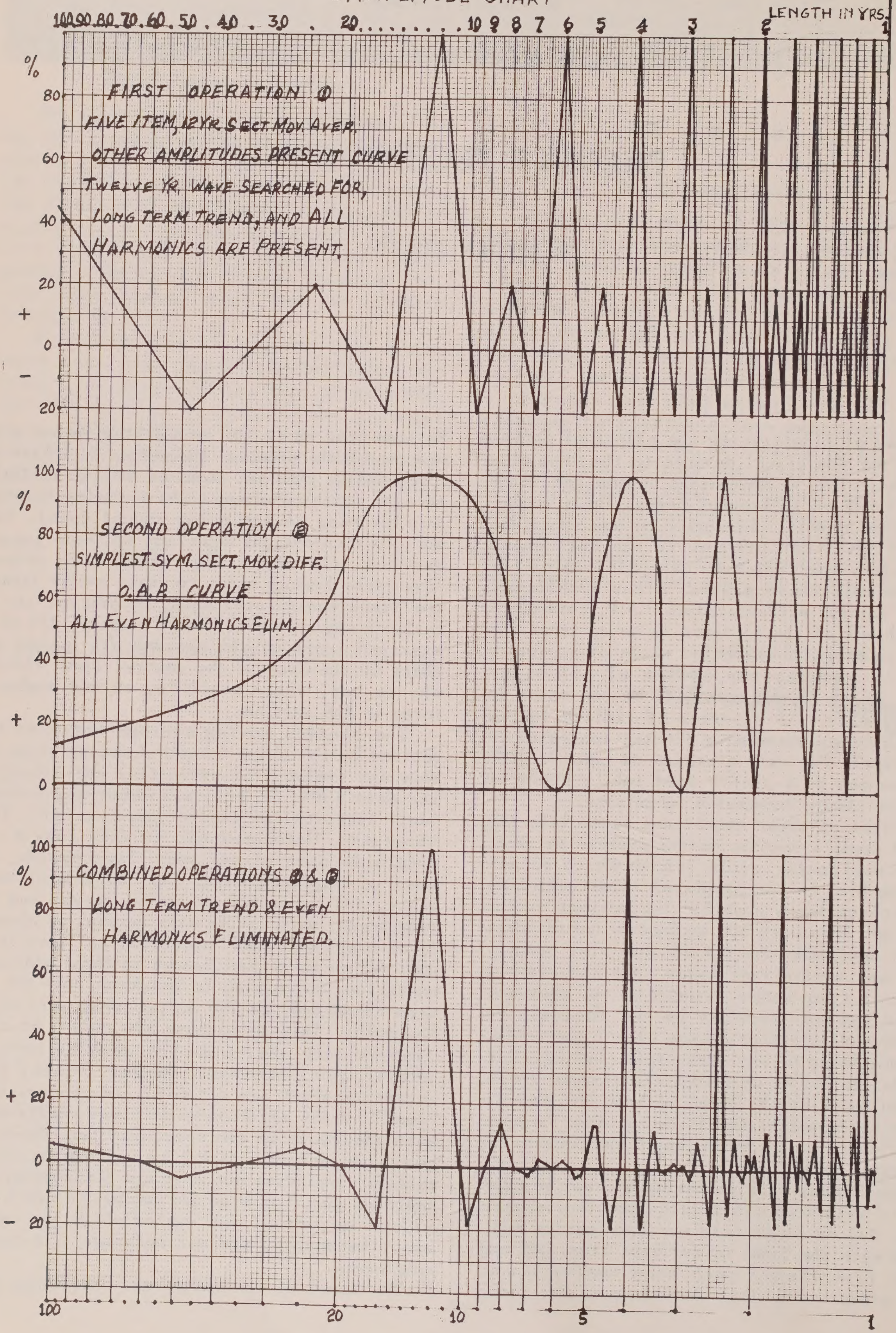
The first of these operations is to take the data and apply a section moving average to them, for the particular cycle length which we are searching for. In the graphical illustration we are searching for a possible twelve-year cycle. When we get thru with our successive operations, the last amplitude chart will show what percentage of any twelve-year cycle that was present in the data (tho hidden perhaps by the presence of other cycles) remains in the manipulated data. Our manipulations do not affect the period length, or timing of any such cycle, but only the amplitude. So, if we do find a twelve-year cycle, after manipulating the data, we know how much to increase the apparent amplitude in order to have a true picture of the cycle which was present in the original data.

The particular section moving average we have chosen to illustrate is a five-item twelve-year section. All we do is take our time series and, starting with the first or earliest item, add and average five items, each item twelve years farther along in the data than the previous item. We then move on to the second item in our series and repeat the process. The series must have five times twelve plus one items of data in it for our section moving average to have twelve points in it (assuming we are using annual data). Since our other operations also "use up" some items at each end, the series must actually be seventy-five years long in order to leave twelve items in the final manipulated data. So you can see why analysts shy away from "short" series. All of the averaged items of our section are posted on a chart at the date of the central item which is why we use, where possible, an odd number of terms in the section.

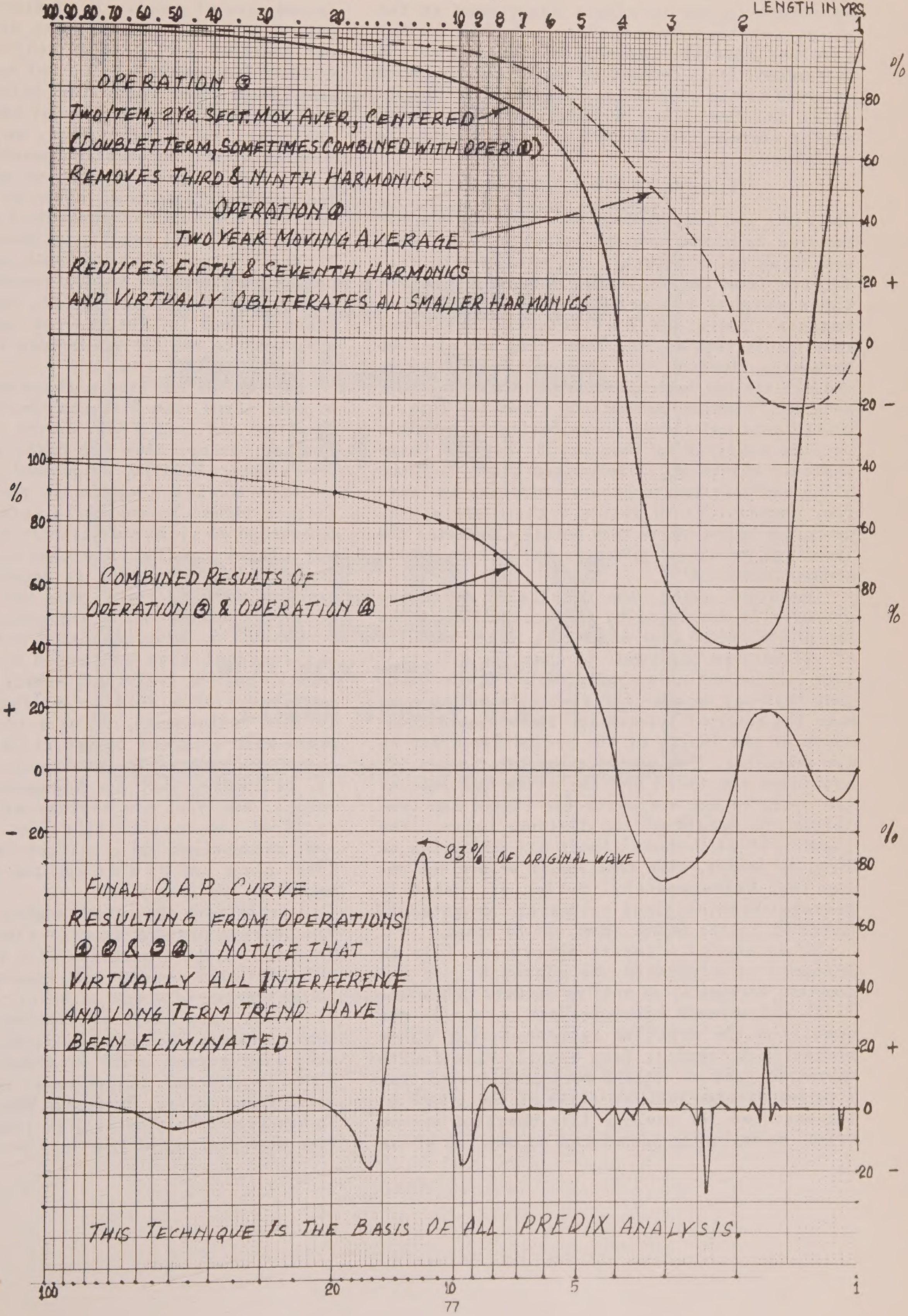
The section moving average which we have derived by the above described manipulation will show any twelve-year cycle that was present in the data 100%. It will also show any harmonic (unit fraction) of twelve years, as six, four, three etc. Unfortunately it will show a considerable part of any very long cycles, and hence of long term trend. But, outside of twelve years, and harmonics of twelve years, and long term trend, very little will remain, as shown by first graph entitled "operation 1." This is not good enough so we must resort to three additional operations calculated to knock out both the long term trend and, as far as possible, all of the harmonics. This is because the cycles which we find in time series do not seem to have, in general, exact harmonics, but only NEARLY EXACT harmonics which are actually independent other "real" cycles which have no fixed relationship with the cycle we are searching for. Hence the complex wave forms which a section moving average reveals, including not only the fundamental wave searched for, but also all harmonics and a considerable part of any cycles which are nearly exact harmonics, are not reliable forecasting components.

The first of the additional operations which

AMPLITUDE CHART



AMPLITUDE CHART



OPERATION ③

TWO ITEM, 2 YR. SECT. MOV. AVER., CENTERED
(DOUBLET TERM, SOMETIMES COMBINED WITH OPER. ①)
REMOVES THIRD & NINTH HARMONICS

OPERATION ④

TWO YEAR MOVING AVERAGE
REDUCES FIFTH & SEVENTH HARMONICS
AND VIRTUALLY OBLITERATES ALL SMALLER HARMONICS

COMBINED RESULTS OF
OPERATION ③ & OPERATION ④

83% OF ORIGINAL WAVE

FINAL O.A.P. CURVE
RESULTING FROM OPERATIONS
①②&③④. NOTICE THAT
VIRTUALLY ALL INTERFERENCE
AND LONG TERM TREND HAVE
BEEN ELIMINATED

THIS TECHNIQUE IS THE BASIS OF ALL PREDIX ANALYSIS.

we resort to has an effect diagrammed in the graph entitled "operation 2." This is the simplest possible symmetrical section moving difference. It is derived by taking the following weighted moving average, or "section," as PREDIX calls it. Described in terms of a weighted moving average, the distribution of weights is as follows:

-¼,0,0,0,0,0,½,0,0,0,0,0,-¼

the right and left-hand weights are half a cycle removed from the central weight. If we were searching for a possible cycle of period difference from twelve years, we would separate these weights by correspondingly different amounts. Operation 2 effects two principal results. It removes long-term trend and all even harmonics, leaving only the searched for cycle and all its odd harmonics, as shown in the graph entitled "combined operations 1 and 2." This is pretty good and it may occasionally be possible to stop analysis at this point, but the third harmonic sticks up, like a sore thumb, and the fifth and seventh and others remaining are very poor company. So we devise a third operation, described below, which very cutely eliminates the third and the ninth harmonics, and at very little computational cost.

Operation three, the results of which are graphically displayed by the solid line at the top of the second page of graphs, is the simplest of all devices employed. It consists of a two-item section moving average, posted at the date, just half-way between the items. In our case we make the interval between the items exactly one-sixth of the length of the period for which we are searching. This operator has two virtues. It nullifies the third and the ninth harmonic of the cycle we are searching for (twice and two-thirds the length of the distance between the items). It also shows almost all of cycles as long, or longer, than that length we are searching for. Unfortunately, cycles of length in between these critical values are revealed IN REVERSE, to the degree shown by the graph.

So we employ a fourth operation. This is designed to eliminate the eleventh, and all shorter, harmonics, as well as greatly reduce the fifth and seventh harmonics and partially get away from the negative representation which operation 3 created. Very happily this fourth operation need be nothing more complicated than a moving average just one-sixth of the length of the searched for period. This operator has an effect shown by the dotted line at the top of the second page of graphs. It eliminates anything of period near that of one-sixth of the length of our searched for cycle as well as all shorter cycles. The combined effect of operations three and four is shown immediately below in our graphs.

If we graph the results of each step in the analysis, as we have done, we can find the results of two successive operations by multiplying each corresponding point of the graphs of the two amplitude curves. When we have done this for all four of our described operations we arrive at a final result, as shown by the graph at the bottom of the second page of O.A.P. curves. Notice that hardly anything except the searched for cycle is present, and this is very sharply tuned in. The devices used are exactly analogous to the tuning devices incorporated in our radios and TV sets.

Suppose we had used a section moving average of more terms than five, in the first instance? The first and last O.A.P. curves would have been similar, except that the peaks would all have been sharper. PREDIX, in general, uses as long a section moving average as possible, up to fifteen terms. No series is sufficiently homogeneous and no cycle sufficiently regular to allow any closer tuning than this. There are, of course, those who think it presumptious to use anything more analytical than the deviation of a series from its moving average, of some given length. It is true that this device does show any dominant wave of period at or near this length, but the analytical acuity of the device, compared with a section moving average plus further refinements, is as a blunderbuss compared with a modern target rifle equipped with telescopic sights. The whole point at issue here is, of course, just how homogeneous is any time series, and just how regular are its presumed cyclical components? It's just a question of what assumptions one considers justified in the first place and of what are the results of the method in the last place.

I do believe that about eighty percent of the fluctuation present in most time series which are part of the statistics of a relatively free and unfettered economy will eventually be proven to be the sum of a set of nearly regular periodicities. Naturally, if someone drops an atom bomb somewhere, not only millions of people, but many time series, will be suddenly and unpredictably affected. But perhaps, if and when that awful event occurs, Professor Wheeler's index of International Battles will be jiggled right into line with what seems like very periodic behavior.

A FOUNDATION REPRINT

CYCLICAL ANALYSIS

Industrial Common Stock Index

1854 - 1951

PREDIX

P. O. BOX 1245 DEPT. A
CORAL GABLES, FLA.

Copyright, July 1951, By Predix

EDITOR'S NOTES

As originally published, Predix consisted of a three-color chart, 36 x 22 inches in size, and a 24-page booklet.

The original chart has been cut up into 8 sections and reprinted, in black and white, on pages 86 to 93 inclusive.

The booklet is reprinted on pages 79 to 85 inclusive and pages 94 to 98 inclusive.

Four additional pages, supplied by Mr. Hughey, have been printed on pages 75 to 78.

Certain problems have been created for the reader by cutting up the large chart into eight pieces and by printing in black and white instead of in three colors.

First of all, the explanations, formerly on one sheet of paper where they could all be read at once, must now be read variously on pages 86, 87, 88, and 89. Be sure to read the text on all these four pages before trying to understand any of the charts.

Second, you will find reference to "the red curve," "the blue curve," etc. all of which curves are now printed in black. Also you will find references to "the curve below" etc. which now apply to curves on another page.

By way of explanation the following comments may be helpful:

Page 86

This page refers to the data used and describes the methods.

Page 87

"The saw tooth waves in red below..." are the saw tooth curves now printed in black in four sections on pages 90, 91, 92, and 93.

"The long term asymptotic growth trend, explained in accompanying text, is the gradual curve shown in red running thru the entire series" is, of course, now printed in black. To identify it, I have labeled it "A."

"The sum of the periodic components plus the trend is shown in red as the smooth curve approximating the actual movements of the Industrial Common Stock Index." To identify it more clearly, I have labeled it "B."

"...the Industrial Common Stock Index....is exhibited as a step graph, in black, for each quarter of each year," This curve, of course, remains in black and is called "C."

Note that on both pages 86 and 87, the scale is arithmetic and represents logs of the index; on pages 88 and 89 the actual values are plotted on ratio or semi logarithmic scales. The scales have been adjusted so that they are interchangeable.

The explanation of the curves "D" and "E," at the top of pages 86 and 87 will be found on pages 88 and 89.

Page 88

"The step graph, about the red axis..." refers to curve "D." The "red axis," now black, is labeled "E."

Note that the axis, "E," represents 100% or, in logs, 2.000.

Note also that the scale in the lower half of page 88 is for logarithms, as on page 86 and 87.

Page 89

"The blue smooth curve through the step graph....." refers to curve "F."

Note that the grid to the left of the comments, on this page, is for curves "D," "E," and "F," expressed as logarithms; the grid and scale to the right of the comments is a ratio or logarithmic scale applying to the curves "A," "B," and "C" at the top of the page.

Remember that the forecast, plotted on page 89 represents the combined effect of the longer cycles only. It is modified **importantly** by the medium and short term cycles subsequently isolated and to be reported upon in the April and May Reports.

erd

A CYCLICAL ANALYSIS

INDUSTRIAL COMMON STOCK INDEX, 1854--1951

By PREDIX

The subject of cyclical analysis is by no means new. In the middle of the last century, when the compiling and reporting of statistical indices gradually became widespread, early students of time series analysis noted many striking examples of regular fluctuations extending over many decades. In the course of time, three basic schools of thought developed.

The first, in essence, interpreted the "waves" in each particular series as having some typical pattern which tended to repeat, with an approximately constant period. The second school of thought developed later and probably includes most present day economists. These believe that our economy in general goes thru regular phases of boom, bust, depression and recovery in succession and that, altho this is inherent in the natural working of our free economy, these business cycles vary in length and severity, each one a case by itself. They attempt to appraise the length and extent of each cycle by various studies which might be crudely summarized as "cross-sectional" analysis. It is possible that this picture of our economic society is the only true one. But there is increasing evidence that a third school of thought must be given, at the very least, serious consideration.

This is the now rapidly growing group of investigators and students who believe that much evidence has been accumulated to the effect that almost all time series display, to an important degree, a great many nearly exact periodicities, or cycles, all contributing independently to the total fluctuation of the given series. But two very perplexing difficulties beset those who have become convinced by this mass of evidence and who seek to round out the theory and apply it in practice.

The first great stumbling block is the fact no logical causal factors or forces have been uncovered to explain why these regular cycles exist. Only faint glimpses of plausible "reasons why" have been discerned, and only the boldest of assumptions would warrant their acceptance. The most outstanding of attempts to track down the origin of our observed waves is embodied in a Report, by Carlos Garcia-Mata and Felix I. Shaffner, printed in the Quarterly Journal of Economics, Vol. XLIX, November 1934, and as Reprint No. 10, Foundation for the Study of Cycles, Riverside, Connecticut (available at nominal cost to members).

In this "Report," a very misleading title for the substantial statistical work it is, a serious attempt was made to substantiate Jevons classical hypothesis concerning sun spots and business cycles. ("The Periodicity of Commercial Crises and its Physical Explanation," read at the meeting of the British Association on August 19, 1878.) This famous hypothesis asserted that variations in sunspot activity producing a variation in solar radiation received on earth, affected agricultural crop production which, in turn, accounted for business cycles.

The net result of the Report was that, while little correlation could be observed between sunspot variation and crops, if the rate of change of sunspot activity was compared with total commercial activity and industrial production, excluding crops, the correlation was startling, to say the least. In other words, when solar radiation received on earth was increasing, commerce and production were correspondingly high, and when solar radiation received was decreasing, commerce and production were correspondingly low, over a period of seventy odd years.

It is easy to understand that sunspot activity, which affects solar radiation, can be the result of tides in atomic fire storms reverberating thruout the sun, determined by the physical constants of the sun as well as the periodic ebb and flow of the complex variation of the combined gravitational fields of the planets, and hence can be a complex of periodic factors. It is not easy to understand how our whole economic society could be caused to surge and recede accordingly.

The second stumbling block to students of cyclical analysis, which has been largely responsible for the very slow development of this promising field of research, derives from the harsh and painful fact that any attempt to isolate periodic components from a time series involves very extensive computational work, and ordinary computational machinery, such as the I. B. M. punched card devices, is not only expensive to employ but basically awkward and difficult to use in time series work.

The theoretical approach is best explained in a book by O. W. Blackett and W. P. Wilson entitled **A Method of Isolating Sinusoidal Com-**

ponents in Economic Time Series, publisher University of Michigan: - "Michigan Business Studies" Vol. VIII No. 4. Unfortunately, the application of their otherwise ideal methods requires the solution of determinants of very large order as well as a great deal of ordinary computational work. Even one time series of a few hundred items would require considerable use of "Electronic Brain" calculating equipment, at two or three hundred dollars an hour.

So in practice, resort is made to three very simple devices. These devices, simple as they are, will always suffice, by repeated application, to reduce a series to its cyclical components, if any exist. We refer to (1) the moving average and its corollary, the deviation of a series from a given moving average, (2) the section moving average and (3) the section moving difference. The proper use of these devices reveals directly any periodic content in a series providing the series extends over a sufficiently long time base. In case of the Predix analysis, section moving differences were used. All of these devices will be briefly described below, as well as the derivation of a long term trend which is of course considered separately from periodic components.

This does not mean that there is not a great deal of work to be done. Not only do about a hundred section moving differences have to be taken, some of them specially constructed to avoid being disturbed by known waves of nearby length, but the first results must be treated as an approximation and the entire process repeated with the residue several times. Residue number six looked to the author like a good place to stop.

Mention should be made here of another valueable analytical tool, namely multiple harmonic analysis. Harmonic analysis consists of a rather arduous and extended mathematical procedure which enables one to express any given curve as a set of sine waves of various amplitudes. The set consisting of one wave of period equal to the whole length of the curve given and one of length equal to each successive harmonic (as one half, one third, one fourth etc,). The interesting property of the solution is that it not only duplicates the curve but then repeats exactly over successive lengths equal to that of the original curve, called the fundamental. This is not directly helpful to us but, if we take a number of progressively longer fundamentals and plot each solution, then "real" waves present will appear as maximum points on the resulting "periodigram" as it is called.

The same periodigram can be derived by repeated application of section moving differences, and these show not only the periods present, but also the turning points not revealed by the multiple harmonic analysis, at least when this is done in the only practical way and that is by using an Henrici Harmonic Analyzer. These serve, when used for this purpose, principally to save time and to verify later work. Incidently they cost a small fortune.

In spite of these difficulties, investigators have revealed in hundreds of important series a substantial and often predominant degree of unquestionable periodic content. A common criticism is that, since any arbitrary series (in general) can be reduced to a set of regular waves, therefore it doesn't prove anything to so display an economic time series. The common sense reply is simply that if many series are so treated, and forecasts made, and the forecasts prove valuable, then the theory has served its purpose and warrants continued use until something better is devised.

And so, to help forward such a program, Predix thought the Common Stock Index was a good subject with which to make a beginning.

Technical Notes

A moving average of a given series is a derived curve every point of which is an average of a certain number of terms of the given series immediately preceding and following that point. It has the interesting property that waves of length equal to the number of terms averaged and present in the given series will not appear in the moving average. Thus the difference between (deviation from) the given series and its moving average of N terms will consist mainly of any wave of period equal to N items (and any harmonics). Unfortunately waves of nearly the same period will also be present in substantial degree. The advantage of this device is that it faithfully reveals local distortion and gives the investigator the feeling of looking at the "real" wave.

Much more useful is a section moving average of a given series. It is a derived curve every point of which is an average of a certain number of terms of the given series, each term a fixed number of items apart from adjacent terms, the point being plotted at the central item. It reveals waves of period length equal to the distance between consecutive terms taken to construct the section average. It also reveals any harmonics of such a wave. If N terms are used then waves whose period differs by only 1/N times that of the revealed wave will be eliminated. Unfortunately, certain critical period lengths will be partially revealed in reverse, which can be quite confusing.

A still better device is the section moving difference. This is simply a section moving average minus its own value half of the term difference preceding (or ideally, minus one half its own value at half of the term difference preceding and following). The section moving difference reveals waves of period length equal to the term difference and all the harmonics except the second, fourth, eighth etc. It also removes long term trend which is present in the other devices.

A further refinement consists of taking doublet instead of individual terms. That is, replacing each term with two terms a certain distance on either side of the original term. If the distance separating the doublet members is equal to one third of the period of the revealed wave, then the third, sixth and some higher harmonics are removed. The amplitude of the revealed wave is reduced approximately one third. The fifth harmonic is greatly reduced and we have an almost perfect analytical tool. This was used in the Predix analysis.

The critical period lengths which appear reduced but in reverse in the application of these devices can be eliminated by centrally weighting the terms used in constructing the section but this adds greatly to the computational work and is not really essential except in unusual situations.

The performance of all of these devices can be demonstrated mathematically by repeated application of the trigonometric formulae for $\sin(X+Y) + \sin(X-Y)$ and curves plotted showing percentage of other amplitudes present when any particular section is applied. These statistical tools are exactly analogous to wave filters used in frequency analysis in acoustical and electrical engineering.

For the long term trend it was decided to use an asymptotic growth curve since these have proved much more satisfactory than straight line trends in almost all long time series. The simplest of these is given by the formula

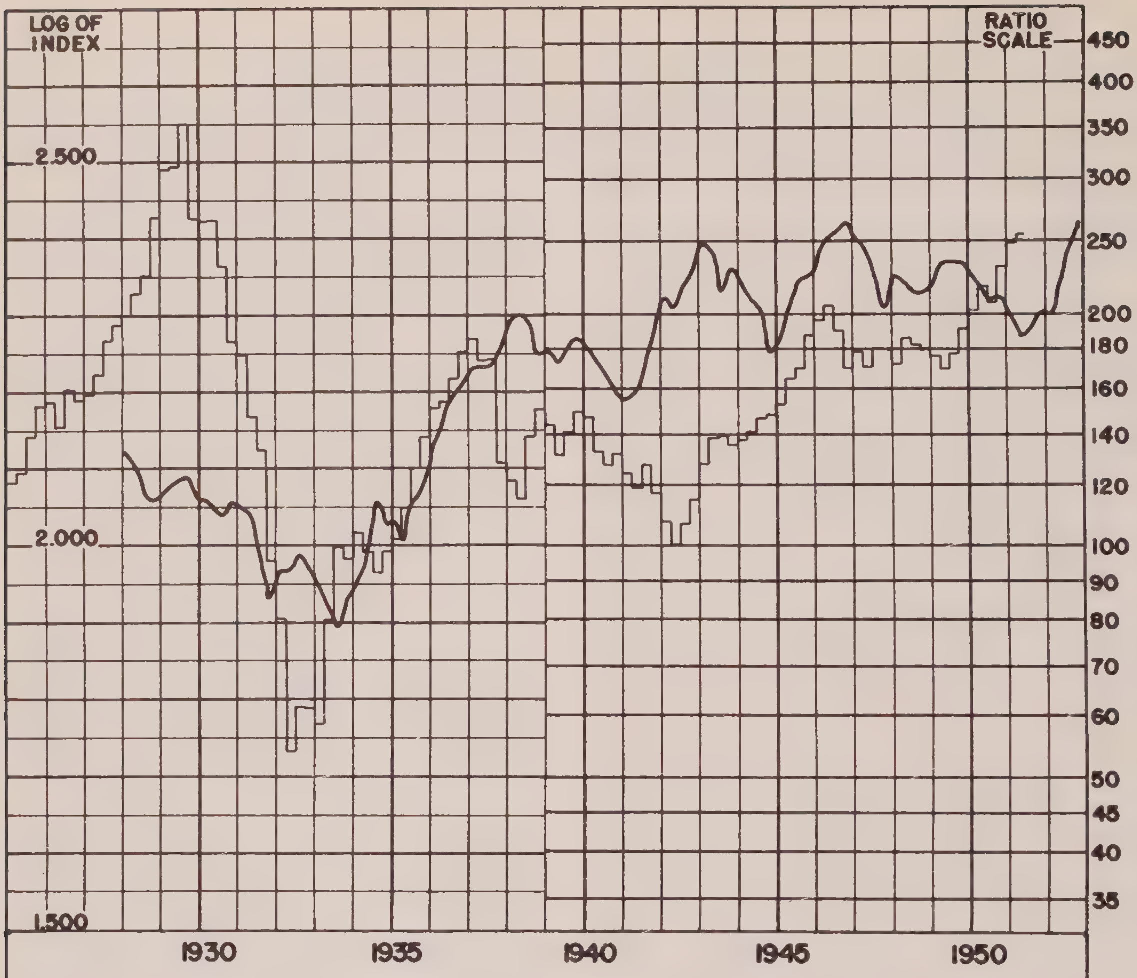
$$\text{LOG OF INDEX} = A + \frac{B}{X+C}$$

where X is the time variable. The three values required to determine the constants were arrived at by averaging the first and second quartile, second and third quartile and third and fourth quartile of the index data. These values were corrected to compensate for the fact that an average of a convex curve is always slightly lower than the true value. They were further slightly adjusted to accomodate a slight increase in curvature indicated by the sixth residue. Final values arrived at for the constants were: $A = 9.48$; $B = -4237.53$; $C = +440.731$

ASYMPTOTIC GROWTH TREND VALUES FOR EVERY FIFTH YEAR

1850.125	.848	1855.125	.936	1860.125	1.016
1865.125	1.097	1870.125	1.180	1875.125	1.265
1880.125	1.345	1885.125	1.422	1890.125	1.497
1895.125	1.573	1900.125	1.647	1905.125	1.717
1910.125	1.787	1915.125	1.856	1920.125	1.924
1925.125	1.993	1930.125	2.059	1935.125	2.123
1940.125	2.184	1945.125	2.246	1950.125	2.306
1955.125	2.367	1960.125	2.427	1965.125	2.485
1970.125	2.541				

The following page displays a test forecast by a simplified method, based only on prior data. Instead of showing two critical periods such as 1928—1934 and 1945—1951, as inferred in our advertising, we decided to show the whole period, 1928 thru 1953. For so crude a test, results are rather surprising.



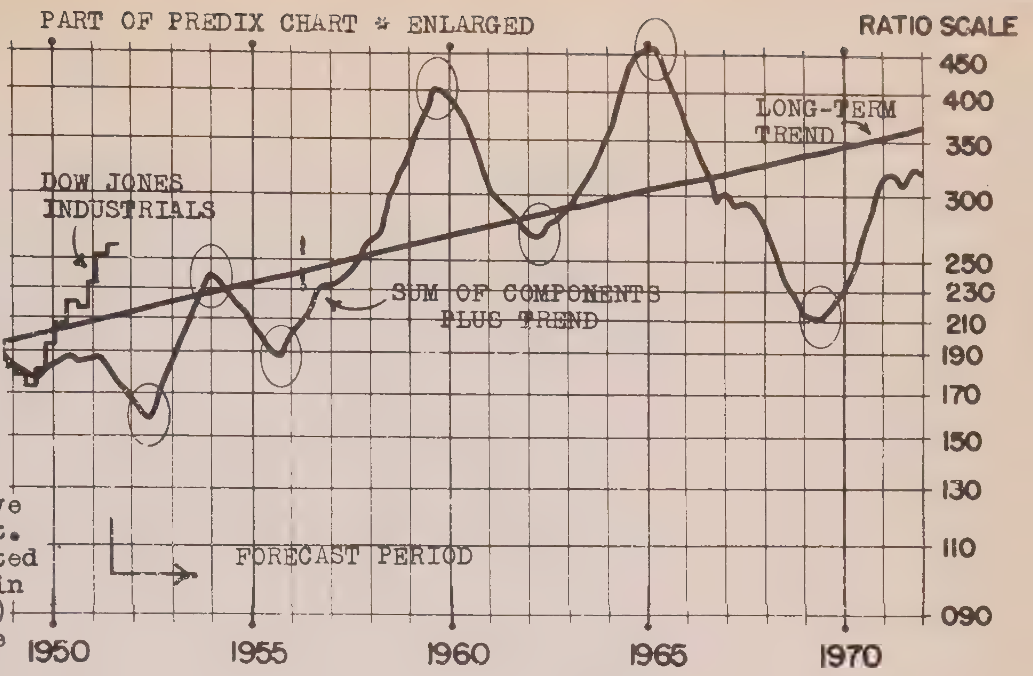
A test forecast of the industrial common stock index from the first quarter of 1928 thru the year 1953 based only on prior data. Due to the particular method used the forecast is actually based on data no later than 1915.

Specifically the forecast is a 2 item - 37 year moving average of quarterly data, projected 37 years and increased by an amount equal to the average increase in long term trend over a period of 55½ years. This is the simplest possible type of periodogram analysis.

The justification for applying this particular method lies in the fact that a preliminary testing of the index for periodic content reveals a number of waves most of which are approximate harmonics of 37 years Hence every 37 years should approximately repeat, if long term-trend is added.

In this test forecast it seems rather significant that a downturn is indicated before 1929 and a bottom within a year of the actual low. This is followed by major market moves and turning points of fair approximation to actual market action. Such a test is a very crude approach to the elaborate analysis involved in the Predix Chart itself but should assure the doubters as to the existence of real periodic content and forecasting possibilities inherent in this time series.

EXPECTED RANGE OF ERRORS IN TIMING AND PRICE LEVEL AT MAJOR TURNING POINTS:-



At the right is the last part of your Predix Chart, enlarged, showing the Dow Jones Industrials from the last quarter of '48 thru the second quarter of '51, together with the sum of all the regular cycles so far isolated plus the long term trend.

When these latter are assumed to continue as in the past, and the result is projected into the coming years, they produce the curve shown and labelled forecast.

Since we have not attempted to show any waves shorter in years than 2.82 (33 months) and since some of these are quite substantial, we find that the sum of our components plus trend is always a little high or low, and never quite a perfect fit to the actual market.

We have tried to select corresponding points on the Dow Jones Index (or extension) and on our Sum of Components plus Trend at all past major turns. These are listed on the preceding and following pages. If we average the past errors in timing and price level we find that major turns indicated in the forecast should have an average error of 5½ months, early or late, and plus or minus about nine percent, of the actual market turning point. These areas of probable actual future turning points are shown by the ovals.

DOW JONES AND EXTENSIONS 1854.125 - 1951.375

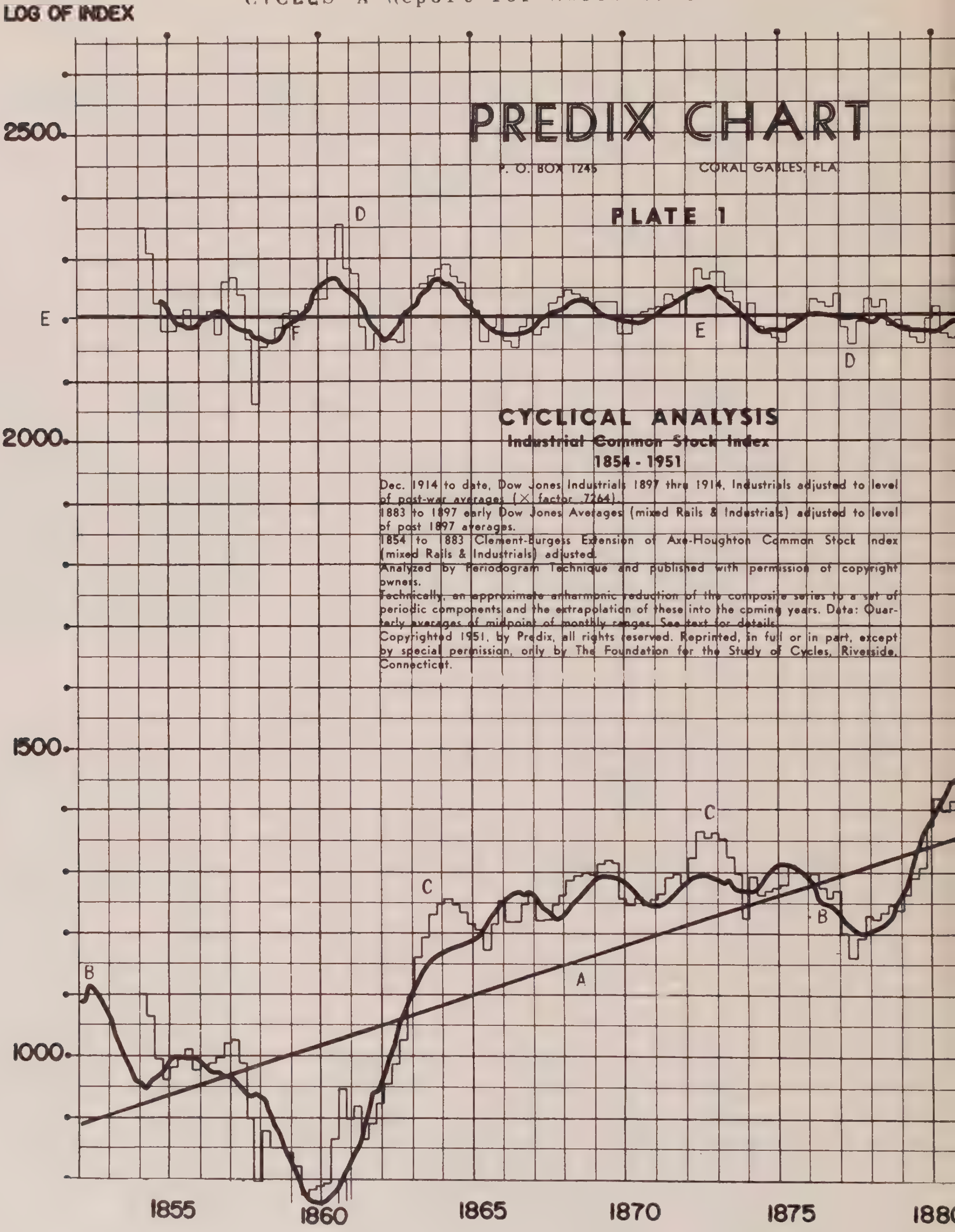
MAJOR CORRESPONDING TURNING POINTS OF INDEX AND SUM OF COMPONENTS AND TREND

Date	Sum of Components Plus Trend	Date	Log of Index	Time - Early	Error Late	Price Above	- Error Below
1854.125	.949	1854.875	.956	.750			.007
1855.375	..996	1857.125	1.019	1.750			.023
1859.875	.755	1859.375	.767		.500		.012
1863.875	1.163	1864.125	1.250	.250			.087
1864.625	1.176	1865.375	1.168	.750		.008	
1866.375	1.264	1866.875	1.258	.500		.002	
1867.625	1.222	1867.375	1.215		.250	.007	
1869.375	1.291	1869.375	1.313		.000		.022
1870.875	1.240	1870.125	1.241		.750		.001
1872.625	1.293	1872.375	1.362		.250		.069
1874.125	1.268	1873.875	1.216		.250	.052	
1875.125	1.311	1875.375	1.303	.250		.008	
1877.875	1.198	1877.375	1.154		.500	.044	
1882.125	1.506	1881.375	1.500		.750	.006	
1884.375	1.344	1884.375	1.332	.000		.012	
1886.875	1.520	1886.875	1.548		.000		.028
1887.625	1.516	1888.375	1.489	.750		.027	
1889.125	1.582	1890.375	1.571	1.250		.011	
1890.625	1.530	1890.875	1.511	.250		.019	
1891.875	1.579	1892.375	1.551	.500		.028	
1895.625	1.428	1895.125	1.438		.500		.010
1896.375	1.469	1895.625	1.497		.750		.028
1896.625	1.469	1896.625	1.380	.000		.139	
1900.125	1.746	1899.625	1.731		.500	.015	
1901.875	1.653	1900.625	1.617		1.250	.036	

DOW JONES AND EXTENSIONS 1854.125 - 1951.375

MAJOR CORRESPONDING TURNING POINTS OF INDEX AND SUM OF COMPONENTS AND TREND

Date	Sum of Components Plus Trend	Date	Log of Index	Time Early	- Error Late	Price - Above	Error Below
1902.875	1.674	1901.375	1.731		1.500		.057
1904.625	1.609	1903.875	1.519		.750	.090	
1906.375	1.740	1906.125	1.849		.250		.109
1907.875	1.584	1907.875	1.634		.000		.050
1910.625	1.809	1909.875	1.853		.750		.044
1911.375	1.785	1910.625	1.756		.750	.029	
1913.125	1.823	1912.625	1.822		.500	.001	
1914.625	1.724	1914.625	1.745	.000			.001
1916.375	1.965	1916.875	2.012	.500			.047
1918.125	1.845	1917.875	1.876		.250		.031
1919.875	1.998	1919.875	2.043		.000		.045
1921.625	1.889	1921.625	1.834	.000		.055	
1923.125	2.038	1923.125	2.006		.000	.032	
1924.375	1.984	1923.625	1.956		.750	.028	
1929.125	2.477	1929.625	2.552	.500			.075
1932.875	1.860	1932.375	1.735		.500	.125	
1936.875	2.210	1937.125	2.271	.250			.061
1938.375	2.065	1938.375	2.063	.000		.002	
1939.875	2.210	1939.876	2.175		.000	.035	
1941.875	2.033	1942.375	2.000	.500		.033	
1947.125	2.337	1946.375	2.313		.750		.024
1949.625	2.243	1949.375	2.230		.250	.013	
AVERAGE ERROR			Average	.461	.473	.033	.040
PRICE LEVEL		Percentage Equivalent				+ 9%	- 9%
EARLY or LATE		Time in Months		5½	5½		



PREDIX CHART

P. O. BOX 1245
CORAL GABLES, FLA.

PLATE 1

CYCLICAL ANALYSIS
Industrial Common Stock Index
1854 - 1951

Dec. 1914 to date, Dow Jones Industrials 1897 thru 1914, Industrials adjusted to level of post-war averages (× factor .7264).

1883 to 1897 early Dow Jones Averages (mixed Rails & Industrials) adjusted to level of post 1897 averages.

1854 to 1883 Clement-Burgess Extension of Axe-Houghton Common Stock Index (mixed Rails & Industrials) adjusted.

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Technically, an approximate anharmonic reduction of the composite series to a set of periodic components and the extrapolation of these into the coming years. Data: Quarterly averages of midpoint of monthly ranges. See text for details.

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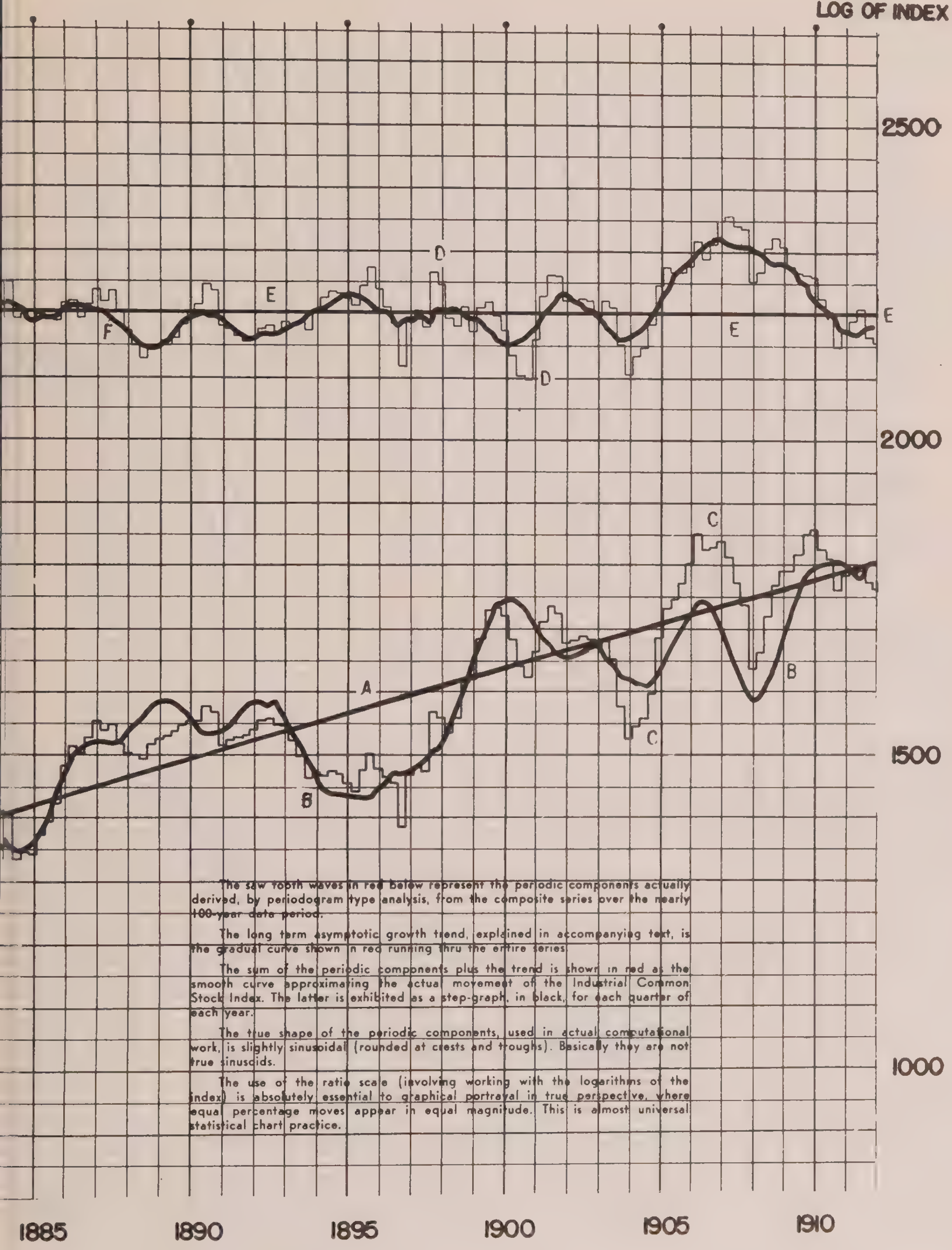


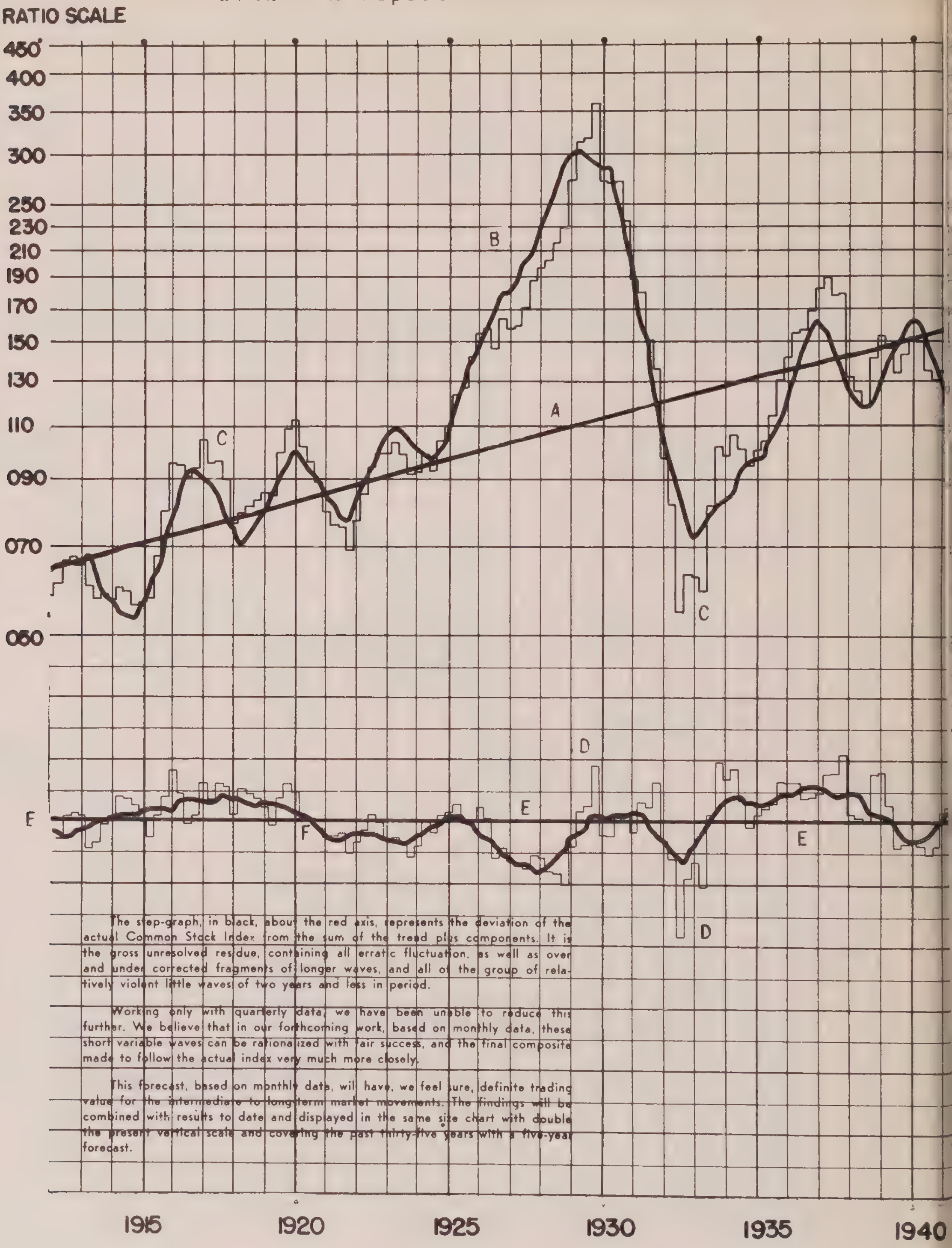
The saw tooth waves in red below represent the periodic components actually derived, by periodogram type analysis, from the composite series over the nearly 100-year data period.

The long term asymptotic growth trend, explained in accompanying text, is the gradual curve shown in red running thru the entire series.

The sum of the periodic components plus the trend is shown in red as the smooth curve approximating the actual movement of the Industrial Common Stock Index. The latter is exhibited as a step-graph, in black, for each quarter of each year.

The true shape of the periodic components, used in actual computational work, is slightly sinusoidal (rounded at crests and troughs). Basically they are not true sinusoids.

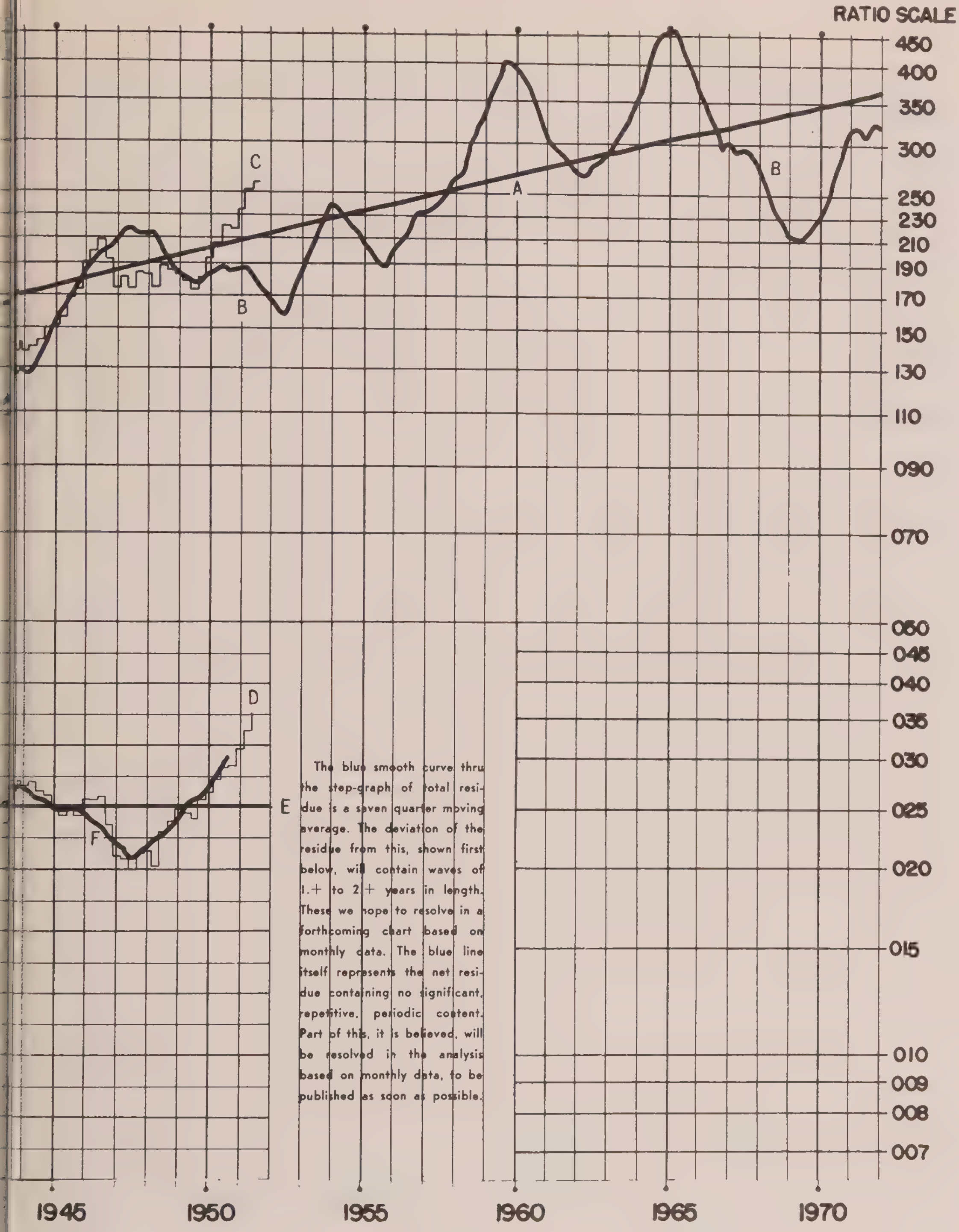
The use of the ratio scale (involving working with the logarithms of the index) is absolutely essential to graphical portrayal in true perspective, where equal percentage moves appear in equal magnitude. This is almost universal statistical chart practice.



The step-graph, in black, about the red axis, represents the deviation of the actual Common Stock Index from the sum of the trend plus components. It is the gross unresolved residue, containing all erratic fluctuation, as well as over and under corrected fragments of longer waves, and all of the group of relatively violent little waves of two years and less in period.

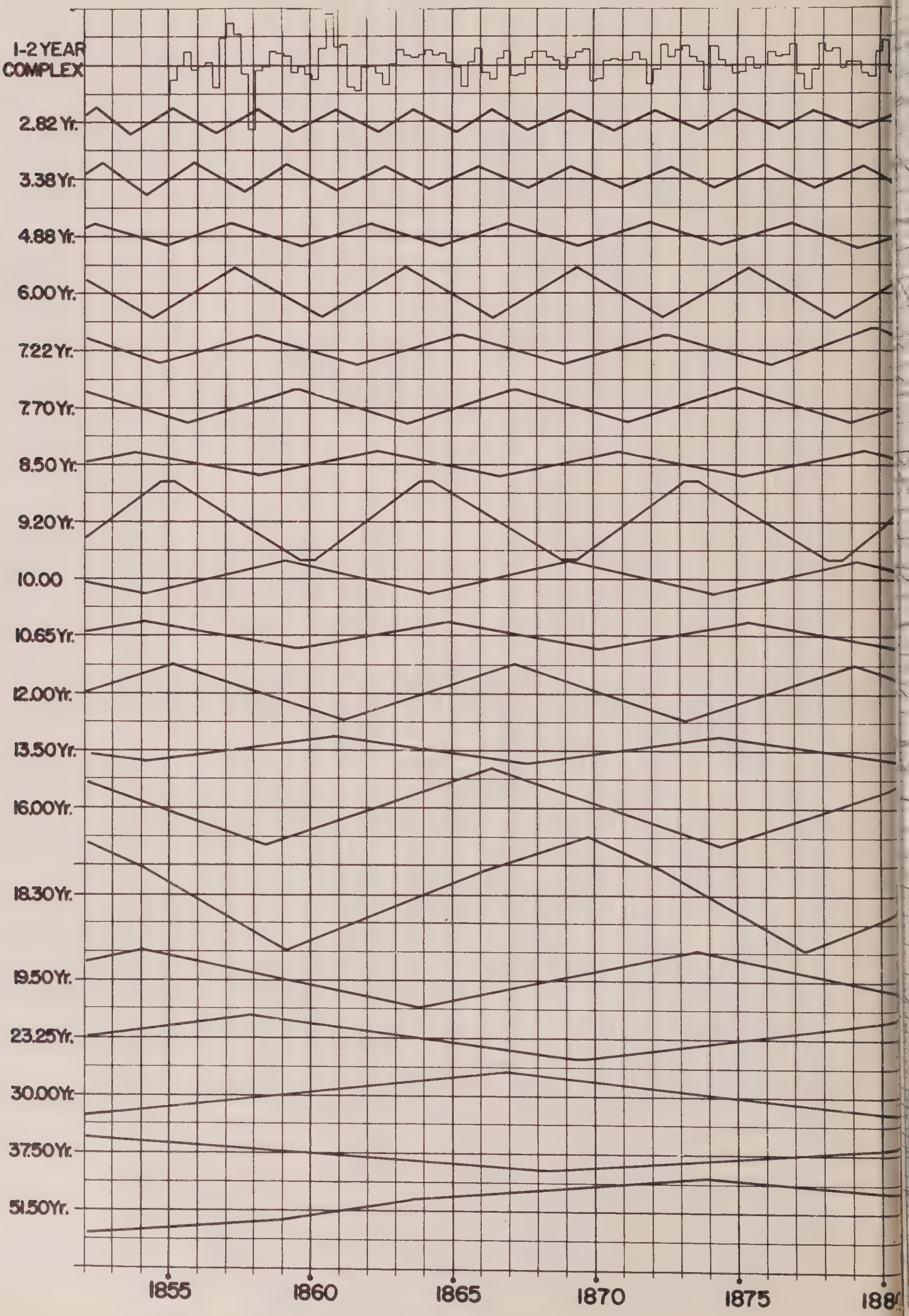
Working only with quarterly data, we have been unable to reduce this further. We believe that in our forthcoming work, based on monthly data, these short variable waves can be rationalized with fair success, and the final composite made to follow the actual index very much more closely.

This forecast, based on monthly data, will have, we feel sure, definite trading value for the intermediate to long-term market movements. The findings will be combined with results to date and displayed in the same size chart with double the present vertical scale and covering the past thirty-five years with a five-year forecast.



The blue smooth curve thru the step-graph of total residue is a seven quarter moving average. The deviation of the residue from this, shown first below, will contain waves of 1.+ to 2.+ years in length. These we hope to resolve in a forthcoming chart based on monthly data. The blue line itself represents the net residue containing no significant, repetitive, periodic content. Part of this, it is believed, will be resolved in the analysis based on monthly data, to be published as soon as possible.

DIAGRAM OF LONG CYCLES ISOLATED,



ING LENGTH, AMPLITUDE, AND TIMING

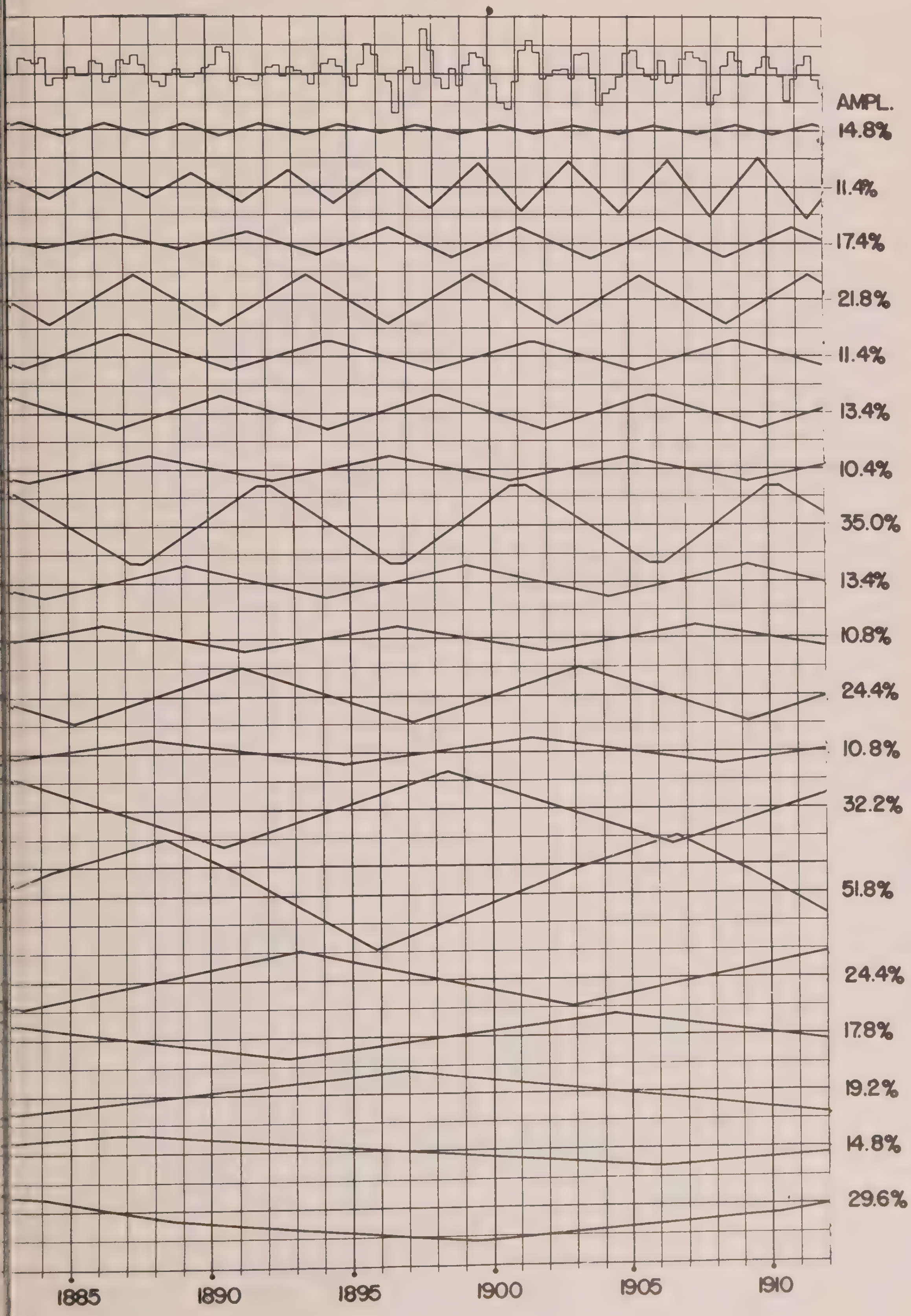
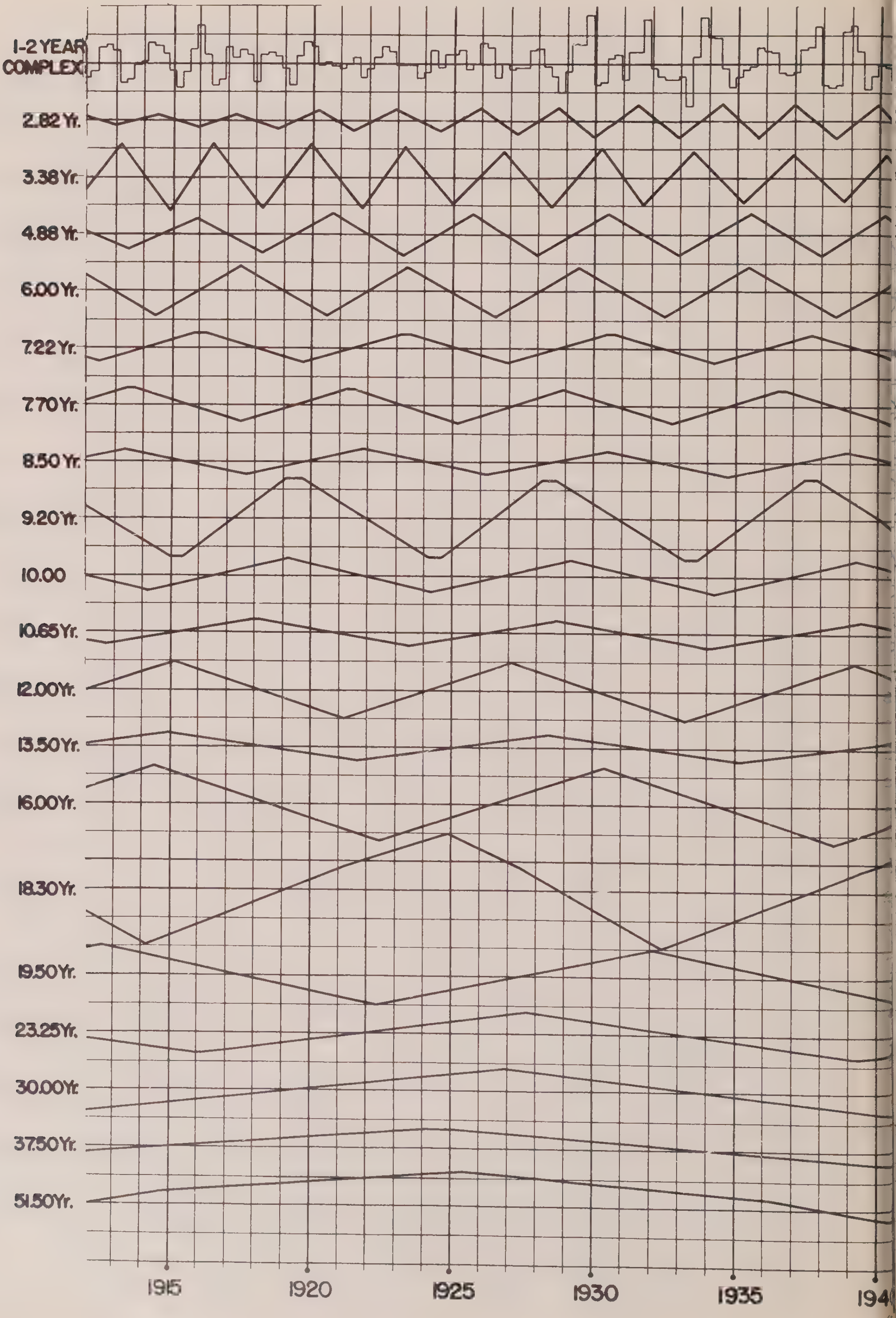
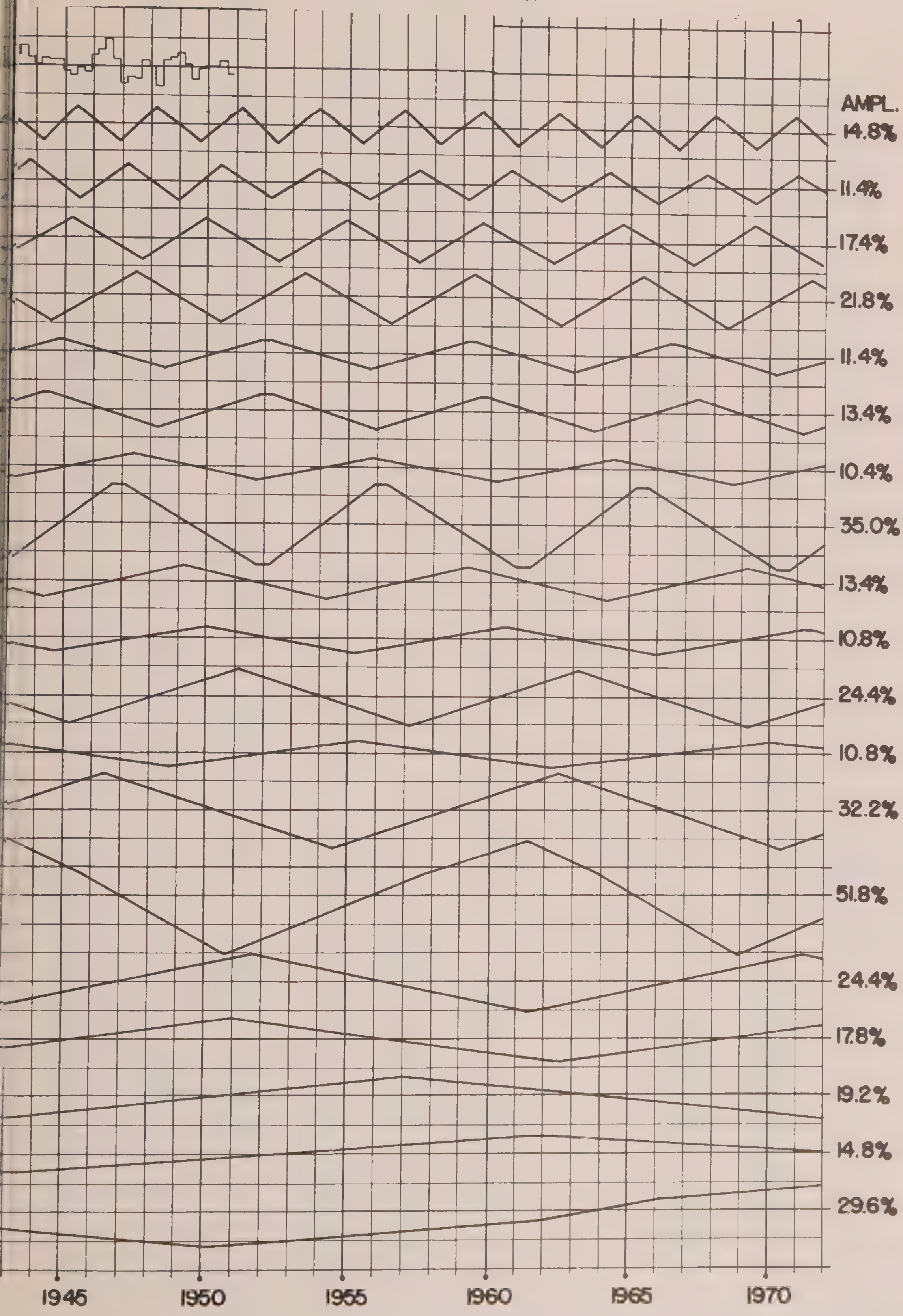


DIAGRAM OF LONG CYCLES ISOLATED, GIVING



TH, AMPLITUDE, AND TIMING --- CONTINUED



Date	Sum of Components & Trend	Log of Index	Residue	7 Item Moving Average	Deviation from Mov. Average
1852.125	1.086				
.375	1.106				
.625	1.097				
.875	1.069				
1853.125	1.039				
.375	1.010				
.625	.981				
.875	.956				
1854.125	.949	1.096	+147		
.375	.956	1.060	+104		
.625	.965	.987	+022		
.875	.978	.956	-022	+033	-055
1855.125	.996	.974	-022	+009	-031
.375	.996	.989	-007	-006	-001
.625	.993	1.005	+012	-008	+020
.875	.993	.972	-021	-009	-012
1856.125	.981	.978	-003	+002	-005
.375	.972	.982	+010	+012	-002
.625	.964	.993	-029	+016	-045
.875	.961	1.016	+055	+013	+042
1857.125	.956	1.019	+063	-007	+070
.375	.945	.980	+035	-015	+050
.625	.932	.894	-038	-017	-021
.875	.929	.786	-143	-027	-116
1858.125	.921	.873	-048	-036	-012
.375	.891	.847	-044	-039	-005
.625	.863	.847	-016	-035	+019
.875	.833	.837	+004	-011	+015
1859.125	.804	.815	+011	-001	+012
.375	.773	.767	-006	+009	-015
.625	.758	.778	+020	+025	-005
.875	.755	.781	+026	+046	-020
1860.125	.759	.785	+026	+055	-029
.375	.769	.861	+092	+066	+026
.625	.790	.941	+151	+061	+090
.875	.816	.893	+077	+050	+027
1861.125	.842	.913	+071	+042	+029
.375	.874	.858	-016	+024	-040
.625	.937	.885	-052	-003	-049
.875	.946	.918	-028	-020	-008
1862.125	.985	.950	-035	-029	-006
.375	1.018	.981	-037	-020	-017
.625	1.063	1.022	-041	-005	-036
.875	1.088	1.094	+006	+008	-002
1863.125	1.113	1.159	+046	+024	+022
.375	1.137	1.189	+052	+041	+011
.625	1.159	1.224	+065	+056	+009
.875	1.163	1.240	+077	+063	+014
1864.125	1.167	1.250	+083	+060	+023
.375	1.174	1.240	+066	+054	+012
.625	1.176	1.229	+053	+038	+015
.875	1.184	1.209	+025	+024	+001
1865.125	1.193	1.199	+006	+012	-006
.375	1.213	1.168	-045	-003	-042
.625	1.228	1.210	-018	-018	0
.875	1.247	1.246	-001	-024	+023
1866.125	1.255	1.213	-042	-025	-017
.375	1.264	1.213	-051	-024	-027
.625	1.260	1.241	-019	-024	+005
.875	1.260	1.258	-002	-021	+019
1867.125	1.248	1.215	-033	-010	-023
.375	1.234	1.215	-019	+003	-022
.625	1.222	1.241	+019	+010	+009
.875	1.225	1.257	+032	+015	+017
1868.125	1.239	1.279	+040	+022	+018
.375	1.253	1.288	+035	+027	+008
.625	1.264	1.294	+030	+028	+002
.875	1.276	1.291	+015	+027	-012
1869.125	1.288	1.309	+021	+016	+005
.375	1.291	1.313	+022	+007	+015
.625	1.286	1.309	+023	+002	+021
.875	1.284	1.251	-033	+0	-033
1870.125	1.271	1.241	-031	-001	-030
.375	1.256	1.254	-002	-003	+001
.625	1.242	1.245	+003	-001	+004
.875	1.240	1.249	+009	+008	+001
1871.125	1.245	1.258	+013	+012	+001
.375	1.252	1.286	+034	+017	+017
.625	1.263	1.291	+028	+027	+001
.875	1.278	1.276	-002	+034	-036
1872.125	1.286	1.317	+031	+042	-011
.375	1.287	1.362	+075	+047	+028
.625	1.293	1.350	+057	+048	+009
.875	1.286	1.357	+071	+051	+020
1873.125	1.280	1.346	+066	+039	+027
.375	1.279	1.318	+039	+031	+008
.625	1.271	1.291	+020	+020	0
.875	1.270	1.216	-054	+005	-049
1874.125	1.268	1.286	+018	-010	+028
.375	1.278	1.257	-021	-021	0
.625	1.295	1.263	-032	-025	-007
.875	1.307	1.268	-039	-018	-021
1875.125	1.311	1.269	-042	-021	-021
.375	1.309	1.303	-006	-015	+009
.625	1.301	1.293	-007	+007	-014
.875	1.289	1.287	-002	-0	-002
1876.125	1.267	1.293	+026	+011	+015
.375	1.247	1.266	+019	+009	+010
.625	1.239	1.251	+012	+003	+009
.875	1.231	1.264	+033	+001	+032
1877.125	1.216	1.195	-021	+001	-022
.375	1.203	1.154	-049	+0	-049
.625	1.199	1.187	-012	+002	-014
.875	1.198	1.223	+025	-005	+030
1878.125	1.202	1.215	+013	-004	+017
.375	1.209	1.232	+023	+0	+023
.625	1.224	1.240	-016	-004	-012
.875	1.248	1.234	-014	-014	0
1879.125	1.276	1.258	-018	-017	-001
.375	1.319	1.281	-038	-018	-020
.625	1.348	1.301	-047	-021	-026
.875	1.376	1.368	-008	-024	+016
1880.125	1.400	1.413	+013	-024	+037
.375	1.423	1.390	-033	-017	-016
.625	1.445	1.408	-037	-008	-029
.875	1.455	1.436	-019	-006	-013
1881.125	1.474	1.489	+015	-010	+025
.375	1.486	1.500	+014	-009	+023
.625	1.494	1.499	+005	-009	+014
.875	1.497	1.484	-013	-007	-006
1882.125	1.506	1.476	-030	-009	-021
.375	1.506	1.468	-038	-009	-029
.625	1.498	1.497	-001	-002	+001
.875	1.475	1.478	+003	+006	-003
1883.125	1.447	1.458	+011	+016	-005
.375	1.420	1.471	+051	+028	+023
.625	1.395	1.441	+046	+026	+020
.875	1.376	1.415	+039	+025	+014
1884.125	1.357	1.402	+045	+021	+024
.375	1.344	1.332	-012	+013	-025
.625	1.347	1.340	-007	+004	-011
.875	1.352	1.338	-014	-003	-011
1885.125	1.373	1.367	-006	-008	+002
.375	1.403	1.389	-014	-004	-010
.625	1.434	1.419	-015	-005	-010
.875	1.466	1.478	+012	-003	+015
1886.125	1.497	1.510	+013	+002	+011
.375	1.513	1.499	-014	+006	-020
.625	1.520	1.522	+002	+012	-010
.875	1.520	1.548	+028	+010	+018
1887.125	1.520	1.535	+015	+003	+012
.375	1.516	1.547	+031	-002	+033
.625	1.516	1.512	-004	-014	+010
.875	1.533	1.499	-034	-026	-008
1888.125	1.552	1.497	-055	-037	-018
.375	1.565	1.489	-076	-049	-027
.625	1.574	1.513	-061	-055	-006
.875	1.578	1.520	-058	-054	-004
1889.125	1.582	1.525	-057	-046	-011
.375	1.580	1.534	-046	-035	-011
.625	1.566	1.543	-023	-020	-003
.875	1.553	1.549	-004	-007	+003
1890.125	1.542	1.549	+007	-003	+010
.375	1.531	1.571	+040	-0	+040
.625	1.530	1.562	+032	-003	+035
.875	1.536	1.511	-025	-009	-016
1891.125	1.542	1.516	-028	-016	-012
.375	1.561	1.521	-040	-026	-014
.625	1.572	1.523	-049	-034	-015
.875	1.579	1.537	-042	-035	-007
1892.125	1.577	1.549	-028	-034	+006
.375	1.575	1.551	-024	-031	+007
.625	1.578	1.542	-036	-027	-009
.875	1.559	1.541	-018	-025	+007
1893.125	1.538	1.517	-021	-021	0
.375	1.513	1.493	-020	-015	-005
.625	1.489	1.460	-029	-005	-024
.875	1.466	1.466	0	+002	-002
1894.125	1.441	1.462	+021	+007	+014
.375	1.435	1.467	+032	+011	+021
.625	1.434	1.463	+029	+021	+008
.875	1.431	1.449	+018	+031	-013
1895.125	1.431	1.438	+007	+033	-026
.375	1.431	1.471	+040	+028	+012
.625	1.428	1.497	+069	+021	+048
.875	1.441	1.475	+034	+006	+028

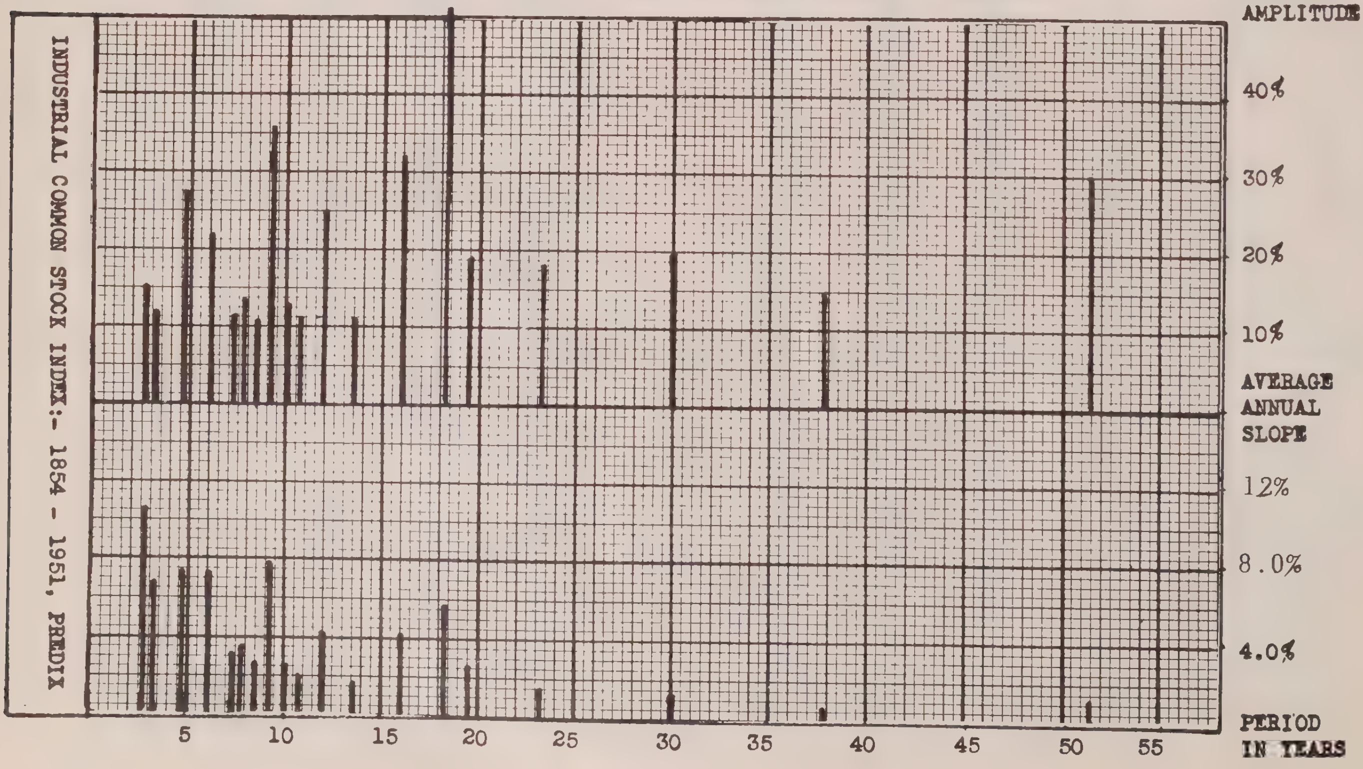
Date	Sum of Components & Trend	Log of Index	Residue	7 Item Moving Average	Deviation from Mov. Average
1896.125	1.460	1.461	+001	+004	-003
.375	1.469	1.450	-019	-002	-017
.625	1.469	1.380	-089	-016	-073
.875	1.474	1.464	-010	-012	+002
1897.125	1.479	1.476	-003	-006	+003
.375	1.491	1.465	-026	-005	-021
.625	1.502	1.564	+062	-013	+075
.875	1.511	1.554	+043	+007	+036
1898.125	1.544	1.533	-011	+003	-014
.375	1.576	1.554	-022	+007	-029
.625	1.606	1.610	+004	0	+004
.875	1.643	1.612	-031	-007	-024
1899.125	1.677	1.680	+003	-010	+013
.375	1.709	1.723	+014	-017	+031
.625	1.739	1.731	-008	-032	+024
.875	1.744	1.714	-030	-042	+012
1900.125	1.746	1.677	-069	-049	-020
.375	1.738	1.637	-101	-047	-054
.625	1.722	1.617	-105	-038	-067
.875	1.704	1.661	-043	-025	-018
1901.125	1.682	1.706	+024	-013	+037
.375	1.673	1.731	+058	+005	+053
.625	1.659	1.717	+058	+023	+035
.875	1.653	1.672	+019	+031	-012
1902.125	1.655	1.676	+021	+027	-006
.375	1.659	1.682	+023	+021	+002
.625	1.664	1.681	+017	+014	+003
.875	1.674	1.665	-009	+004	-013
1903.125	1.658	1.677	+019	-013	+032
.375	1.641	1.648	+007	-027	+034
.625	1.623	1.572	-051	-037	-014
.875	1.618	1.519	-099	-038	-061
1904.125	1.611	1.540	-071	-034	-037
.375	1.609	1.553	-056	-025	-031
.625	1.609	1.592	-017	-009	-008
.875	1.636	1.682	+046	+014	+032
1905.125	1.658	1.729	+071	+034	+037
.375	1.684	1.746	+062	+058	+004
.625	1.704	1.767	+063	+072	-009
.875	1.722	1.800	+068	+082	-014
1906.125	1.737	1.849	+112	+092	+020
.375	1.740	1.825	+085	+105	-020
.625	1.717	1.827	+110	+116	-006
.875	1.689	1.836	+147	+125	+022
1907.125	1.660	1.812	+152	+116	+036
.375	1.631	1.769	+138	+113	+025
.625	1.604	1.736	+132	+112	+020
.875	1.584	1.634	+050	+108	-058
1908.125	1.596	1.660	+064	+101	-037
.375	1.614	1.715	+101	+091	+010
.625	1.650	1.766	+116	+081	+035
.875	1.684	1.787	+103	+083	+020
1909.125	1.714	1.787	+073	+082	-009
.375	1.751	1.814	+063	+071	-008
.625	1.788	1.848	+060	+054	+006
.875	1.794	1.853	+059	+032	+027
1910.125	1.801	1.823	+022	+018	+004
.375	1.804	1.804	0	+007	-007
.625	1.809	1.756	-053	-001	-052
.875	1.806	1.779	-027	-016	-011
1911.125	1.796	1.785	-011	-025	+014
.375	1.785	1.788	+003	-030	+027
.625	1.802	1.765	-037	-022	-015
.875	1.809	1.760	-049	-017	-032
1912.125	1.813	1.779	-034	-016	-018
.375	1.812	1.814	+002	-022	+024
.625	1.815	1.822	+007	-022	+029
.875	1.815	1.818	+003	-016	+019
1913.125	1.823	1.775	-048	-011	-037
.375	1.792	1.755	-037	-006	-031
.625	1.771	1.763	-008	-002	-006
.875	1.752	1.753	+001	+0	+001
1914.125	1.735	1.774	+039	+007	+032
.375	1.732	1.766	+034	+008	+026
.625	1.724	1.745	+021	+010	+011
.875	1.754	1.751	-003	+015	-018
1915.125	1.785	1.757	-028	+020	-048
.375	1.822	1.825	+003	+021	-018
.625	1.860	1.897	+037	+017	+020
.875	1.897	1.975	+078	+017	+061
1916.125	1.932	1.972	+040	+030	+010
.375	1.965	1.955	-010	+034	-044
.625	1.963	1.965	+002	+036	-034
.875	1.954	2.012	+058	+032	+026
1917.125	1.943	1.974	+031	+027	+004
.375	1.921	1.976	+055	+035	+020
.625	1.896	1.947	+051	+041	+010
.875	1.873	1.876	+003	+038	-035
1918.125	1.845	1.893	+048	+036	+012
.375	1.861	1.902	+041	+027	+014
.625	1.880	1.914	+034	+024	+010
.875	1.906	1.925	+019	+032	-013
1919.125	1.932	1.922	-010	+031	-041
.375	1.956	1.991	+035	+027	+008
.625	1.974	2.029	+055	+022	+033
.875	1.998	2.043	+045	+018	+027
1920.125	1.989	2.000	+011	+014	-003
.375	1.971	1.974	+003	+005	-002
.625	1.956	1.942	-016	-007	-009
.875	1.931	1.897	-034	-021	-013
1921.125	1.908	1.876	-032	-028	-004
.375	1.894	1.871	-023	-030	+007
.625	1.889	1.834	-055	-028	-027
.875	1.915	1.879	-036	-024	-012
1922.125	1.940	1.923	-017	-024	+007
.375	1.966	1.968	+002	-026	+028
.625	1.997	1.989	-008	-024	+016
.875	2.023	1.989	-034	-027	-007
1923.125	2.038	2.006	-032	-031	-001
.375	2.028	1.988	-040	-032	-008
.625	2.017	1.956	-061	-034	-027
.875	2.005	1.959	-046	-028	-018
1924.125	1.994	1.989	-005	-022	+017
.375	1.984	1.962	-022	-012	-010
.625	1.999	2.007	+008	-005	+013
.875	2.020	2.034	+014	+002	+012
1925.125	2.059	2.084	+025	+005	+020
.375	2.103	2.097	-006	+008	-014
.625	2.146	2.143	-003	-002	-001
.875	2.165	2.184	+019	-011	+030
1926.125	2.189	2.188	-001	-024	+023
.375	2.219	2.156	-063	-034	-029
.625	2.250	2.204	-046	-044	-002
.875	2.257	2.190	-067	-055	-012
1927.125	2.272	2.197	-075	-064	-011
.375	2.302	2.224	-078	-067	-011
.625	2.326	2.268	-058	-074	+016
.875	2.348	2.287	-061	-070	+019
1928.125	2.384	2.300	-084	-075	-009
.375	2.415	2.328	-087	-061	-026
.625	2.458	2.352	-106	-050	-056
.875	2.473	2.428	-045	-029	-016
1929.125	2.477	2.490	+013	-020	+033
.375	2.474	2.495	+021	-011	+032
.625	2.464	2.552	+088	+006	+082
.875	2.451	2.426	-025	+014	-039
1930.125	2.451	2.425	-026	+009	-035
.375	2.411	2.424	+013	+010	+003
.625	2.353	2.364	+011	0	+011
.875	2.288	2.267	-021	+012	-033
1931.125	2.220	2.249	+029	+011	+018
.375	2.152	2.170	+018	0	+018
.625	2.066	2.126	+060	-014	+074
.875	2.016	1.981	-035	-025	-010
1932.125	1.968	1.905	-063	-039	-024
.375	1.922	1.735	-187	-056	-031
.625	1.887	1.793	-094	-064	-030
.875	1.860	1.790	-070	-046	-024
1933.125	1.874	1.769	-105	-027	-078
.375	1.898	1.904	+006	-003	+009
.625	1.906	1.999	+093	+015	+078
.875	1.917	1.983	+066	+023	+043
1934.125	1.934	2.017	+083	+039	+044
.375	1.965	1.995	+030	+041	-011
.625	1.977	1.965	-012	+031	-043
.875	1.985	1.992	+007	+031	-024
1935.125	1.992	2.009	+017	+028	-011
.375	2.024	2.050	+026	+032	-006
.625	2.041	2.104	+063	+039	+024
.875	2.080	2.142	+062	+043	+019
1936.125	2.118	2.180	+062	+047	+015
.375	2.151	2.186	+035	+054	-019
.625	2.182	2.218	+036	+056	-020
.875	2.210	2.253	+043	+062	-019
1937.125	2.195	2.271	+076	+054	+022
.375	2.165	2.241	+076	+050	+026
.625	2.137	2.243	+106	+044	+062
.875	2.102	2.110	+008	+048	-040
1938.125	2.084	2.086	+002	+048	-046
.375	2.065	2.063	-002	+041	-043
.625	2.070	2.143	+073	+020	+053
.875	2.102	2.178	+076	+013	+063
1939.125	2.134	2.159	+025	+008	+017
.375	2.164	2.119	-045	+002	-047
.625	2.187	2.148	-039	-016	-023
.875	2.210	2.175	-035	-033	-002

Date	Sum of Components & Trend	Log of Index	Residue	7 Item Moving Average	Deviation from Mov. Average
1940.125	2.210	2.169	-041	-034	-007
.375	2.174	2.121	-053	-025	-028
.625	2.143	2.103	-040	-017	-023
.875	2.109	2.122	+013	-004	+017
1941.125	2.072	2.093	+021	+007	+014
.375	2.062	2.075	+013	+013	0
.625	2.047	2.104	+057	+012	+045
.875	2.033	2.068	+035	+006	+029
1942.125	2.039	2.032	-007	+002	-009
.375	2.046	2.000	-046	+003	-049
.625	2.058	2.028	-030	+002	-032
.875	2.071	2.061	-010	+003	-013
1943.125	2.084	2.106	+022	+008	+014
.375	2.091	2.141	+050	+020	+030
.625	2.103	2.142	+039	+027	+012
.875	2.101	2.131	+030	+031	-001
1944.125	2.102	2.138	+036	+027	+009
.375	2.125	2.148	+023	+016	+007
.625	2.152	2.167	+015	+009	+006
.875	2.178	2.170	-008	+002	-010
1945.125	2.206	2.185	-021	-002	-019
.375	2.228	2.217	-011	-004	-007
.625	2.248	2.230	-018	-004	-014
.875	2.267	2.276	+009	-007	+016
1946.125	2.285	2.293	+008	-016	+024
.375	2.299	2.313	+014	-027	+041
.625	2.310	2.280	-030	-039	+009
.875	2.315	2.232	-083	-051	-032
1947.125	2.337	2.251	-086	-063	-023
.375	2.337	2.234	-103	-078	-025
.625	2.331	2.257	-074	-080	+006
.875	2.333	2.257	-076	-072	-004
1948.125	2.334	2.237	-097	-061	-036
.375	2.310	2.269	-041	-048	+007
.625	2.288	2.262	-026	-040	+014
.875	2.265	2.256	-009	-029	+020
1949.125	2.259	2.247	-012	-012	0
.375	2.252	2.230	-022	+003	-025
.625	2.243	2.250	+007	+013	-006
.875	2.262	2.281	+019	+023	-004
1950.125	2.266	2.307	+041	+038	-003
.375	2.274	2.337	+063	+056	+007
.625	2.267	2.330	+063	+078	-015
.875	2.271	2.363	+092		
1951.125	2.273	2.394	+121		
.375	2.254	2.403	+149		
.625	2.237				
.875	2.221				

Date	Sum of Components & Trend
1952.125	2.204
.375	2.197
.625	2.232
.875	2.265
1953.125	2.298
.375	2.328
.625	2.354
.875	2.376
1954.125	2.362
.375	2.346
.625	2.334
.875	2.321
1955.125	2.299
.375	2.278
.625	2.276
.875	2.296
1956.125	2.319
.375	2.338
.625	2.362
.875	2.364
1957.125	2.369
.375	2.381
.625	2.400
.875	2.419
1958.125	2.435
.375	2.468
.625	2.501
.875	2.530
1959.125	2.556
.375	2.586
.625	2.613
.875	2.601
1960.125	2.584
.375	2.563
.625	2.534
.875	2.493
1961.125	2.473
.375	2.461
.625	2.442
.875	2.432

Date	Sum of Components & Trend
1962.125	2.424
.375	2.439
.625	2.446
.875	2.458
1963.125	2.473
.375	2.493
.625	2.513
.875	2.537
1964.125	2.580
.375	2.615
.625	2.647
.875	2.657
1965.125	2.660
.375	2.638
.625	2.607
.875	2.572
1966.125	2.545
.375	2.519
.625	2.469
.875	2.478
1967.125	2.466
.375	2.467
.625	2.463
.875	2.449
1968.125	2.412
.375	2.378
.625	2.350
.875	2.331
1969.125	2.323
.375	2.323
.625	2.340
.875	2.363
1970.125	2.390
.375	2.424
.625	2.465
.875	2.500
1971.125	2.503
.375	2.590
.625	2.512
.875	2.509
1972.125	2.522

PERIODIGRAM OF OVERALL AMPLITUDE AND AVERAGE ANNUAL RATE OF CHANGE



TOP AND BOTTOM TURNING POINTS OF THE 2.82 YEAR WAVE

1850.875	-024	1852.375	+024	1853.875	-023
1855.125	+023	1856.625	-022	1858.125	+022
1859.375	-021	1860.875	+021	1862.375	-020
1863.625	+020	1865.125	-019	1866.375	+019
1867.875	-018	1869.375	+018	1870.625	-017
1872.125	+017	1873.625	-016	1874.875	+016
1876.375	-015	1877.625	+015	1879.125	-014
1880.625	+014	1881.875	-013	1883.375	+013
1884.875	-012	1886.375	+012	1887.625	-011
1889.125	+011	1890.375	-010	1891.875	+010
1893.375	-009	1894.625	+009	1896.125	-008
1897.375	+008	1898.875	-007	1900.375	+007
1901.625	-006	1903.125	+006	1904.625	-007
1905.875	+007	1907.375	-008	1908.875	+008
1910.125	-009	1911.625	+009	1912.875	-010
1914.375	+010	1915.875	-013	1917.125	+013
1918.625	-016	1920.125	+016	1921.375	-019
1922.875	+019	1924.375	-022	1925.625	+022
1927.125	-025	1928.625	+025	1929.875	-028
1931.375	+028	1932.875	-031	1934.375	+031
1935.625	-031	1936.875	+031	1938.375	-031
1939.875	+031	1941.125	-031	1942.625	+031
1944.125	-031	1945.375	+031	1946.875	-031
1948.125	+031	1949.625	-031	1951.125	+031
1952.375	-031	1953.875	+031	1955.375	-031
1956.625	+031	1958.125	-031	1959.625	+031
1960.875	-031	1962.375	+031	1963.875	-031
1965.125	+031	1966.625	-031	1967.875	+031
1969.375	-031	1970.875	+031		

TOP AND BOTTOM TURNING POINTS OF THE 3.38 YEAR WAVE

1850.875	-028	1852.625	+028	1854.125	-028
1855.875	+026	1857.625	-024	1859.125	+024
1860.875	-022	1862.625	+022	1864.125	-020
1865.875	+020	1867.625	-018	1869.125	+018
1870.875	-016	1872.625	+016	1874.125	-018
1875.875	+018	1877.625	-020	1879.375	+020
1880.875	-022	1882.625	+022	1884.375	-024
1886.125	+024	1887.625	-022	1889.375	+022
1891.125	-028	1892.625	+028	1894.375	-034
1896.125	+034	1897.875	-040	1899.625	+040
1901.125	-044	1902.875	+044	1904.625	-048
1906.375	+048	1907.875	-052	1909.625	+052
1911.375	-056	1913.125	+056	1914.625	-060
1916.375	+060	1918.125	-056	1919.875	+056
1921.625	-052	1923.125	+052	1924.875	-048
1926.625	+048	1928.375	-052	1930.125	+052
1931.625	-048	1933.375	+048	1935.125	-044
1936.875	+044	1938.625	-040	1940.125	+040
1941.875	-036	1943.625	+036	1945.375	-032
1947.125	+032	1948.875	-028	1950.375	+028
1952.125	-024	1953.875	+024	1955.625	-024
1957.375	+024	1959.125	-024	1960.625	+024
1962.375	-024	1964.125	+024	1965.875	-024
1967.625	+024	1969.375	-024	1970.875	+024
1972.625	-024				

TOP AND BOTTOM TURNING POINTS OF THE 4.88 YEAR WAVE

1850.125	-016	1852.375	+020	1854.875	-020
1857.125	+020	1859.625	-020	1862.125	+020
1864.625	-020	1866.875	+020	1869.375	-020
1871.875	+020	1874.375	-020	1876.875	+016
1879.125	-026	1881.625	+010	1884.125	-010
1886.625	+014	1888.875	-014	1891.375	+020
1893.875	-020	1896.375	+026	1898.625	-026
1901.125	+026	1903.625	-026	1906.125	+026
1908.375	-026	1910.875	+026	1913.375	-026
1915.875	+026	1918.125	-036	1920.625	+036
1923.125	-036	1925.625	+036	1927.875	-036
1930.375	+036	1932.875	-036	1935.375	+036
1937.875	-036	1940.125	+036	1942.625	-036
1945.125	+036	1947.625	-036	1949.875	+036
1952.375	-036	1954.875	+036	1957.375	-036
1959.625	+036	1962.125	-036	1964.625	+036
1967.125	-036	1969.375	+036	1971.875	-036
1974.375	+036				

TOP AND BOTTOM TURNING POINTS OF THE 6.00 YEAR WAVE

1851.375	+045	1854.375	-045	1857.375	+045
1860.375	-045	1863.375	+045	1866.375	-045
1869.375	+045	1872.375	-045	1875.375	+045
1878.375	-045	1881.375	+045	1884.375	-045
1887.375	+045	1890.375	-045	1893.375	+045
1896.375	-045	1899.375	+045	1902.375	-045
1905.375	+045	1908.375	-045	1911.375	+045
1914.375	-045	1917.375	+045	1920.375	-045
1923.375	+045	1926.375	-045	1929.375	+045
1932.375	-045	1935.375	+045	1938.375	-045
1941.375	+045	1944.375	-045	1947.375	+045
1950.375	-045	1953.375	+045	1956.375	-045
1959.375	+045	1962.375	-045	1965.375	+045
1968.375	-045	1971.375	+045		

TOP AND BOTTOM TURNING POINTS OF THE 7.22 YEAR WAVE

1850.875	+024	1854.625	-024	1858.125	+024
1861.625	-024	1865.125	+024	1868.875	-024
1872.375	+024	1876.125	-024	1879.625	+024
1883.375	-024	1886.875	+024	1890.625	-024
1894.125	+024	1897.875	-024	1901.375	+024
1905.125	-024	1908.625	+024	1912.375	-024
1915.875	+024	1919.625	-024	1923.125	+024
1926.875	-024	1930.375	+024	1934.125	-024
1937.625	+024	1941.125	-024	1944.625	+024
1948.375	-024	1951.875	+024	1955.625	-024
1959.125	+024	1962.875	-024	1966.375	+024
1970.125	-024	1973.625	+024		

TOP AND BOTTOM TURNING POINTS OF THE 7.70 YEAR WAVE

1851.875	+028	1855.625	-028	1859.375	+028
1863.375	-028	1867.125	+028	1871.125	-028
1874.875	+028	1878.875	-028	1882.625	+028
1886.625	-028	1890.375	+028	1894.125	-028
1897.875	+028	1901.875	-028	1905.625	+028
1909.625	-028	1913.375	+028	1917.375	-028
1921.125	+028	1925.125	-028	1928.875	+028
1932.625	-028	1936.375	+028	1940.375	-028
1944.125	+028	1948.125	-028	1951.875	+028
1955.875	-028	1959.625	+028	1963.625	-028
1967.375	+028	1971.125	-028	1974.875	+028

TOP AND BOTTOM TURNING POINTS OF THE 8.50 YEAR WAVE

1850.125	-019	1853.875	+022	1858.125	-022
1862.375	+022	1866.625	-022	1870.875	+022
1875.125	-022	1879.375	+022	1883.625	-022
1887.875	+022	1892.125	-022	1896.375	+022
1900.625	-022	1904.875	+022	1909.125	-022
1913.375	+022	1917.625	-022	1921.875	+022
1926.125	-022	1930.375	+022	1934.625	-022
1938.875	+022	1943.125	-022	1947.375	+022
1951.625	-022	1955.875	+022	1960.125	-022
1964.375	+022	1968.625	-022	1972.875	+022

TOP AND BOTTOM TURNING POINTS OF THE 9.20 YEAR WAVE

1850.625	-070	1854.875	+070	1859.875	-070
1864.125	+070	1869.125	-070	1873.375	+070
1878.375	-070	1882.375	+070	1887.375	-070
1891.625	+070	1896.625	-070	1900.875	+070
1905.875	-070	1910.125	+070	1915.125	-070
1919.375	+070	1924.375	-070	1928.375	+070
1933.375	-070	1937.625	+070	1942.625	-070
1946.875	+070	1951.875	-070	1956.125	+070
1961.125	-070	1965.375	+070	1970.375	-070
1974.375	+070				

TOP AND BOTTOM TURNING POINTS OF THE 10.00 YEAR WAVE

1850.125	+020	1854.125	-028	1859.125	+028
1864.125	-028	1869.125	+028	1874.125	-028
1879.125	+028	1884.125	-028	1889.125	+028
1894.125	-028	1899.125	+028	1904.125	-028
1909.125	+028	1914.125	-028	1919.125	+028
1924.125	-028	1929.125	+028	1934.125	-028
1939.125	+028	1944.125	-028	1949.125	+028
1954.125	-028	1959.125	+028	1964.125	-028
1969.125	+028	1974.125	-028		

TOP AND BOTTOM TURNING POINTS OF THE 10.65 YEAR WAVE

1850.125	-014	1854.125	+023	1859.375	-023
1864.875	+023	1870.125	-023	1875.375	+023
1880.625	-023	1886.125	+023	1891.375	-023
1896.625	+023	1901.875	-023	1907.375	+023
1912.625	-023	1917.875	+023	1923.375	-023
1928.625	+023	1933.875	-023	1939.375	+023
1944.625	-023	1949.875	+023	1955.125	-023
1960.375	+023	1965.875	-023	1971.375	+023

TOP AND BOTTOM TURNING POINTS OF THE 12.00 YEAR WAVE

1850.125	-038	1855.125	+050	1861.125	-050
1867.125	+050	1873.125	-050	1879.125	+050
1885.125	-050	1891.125	+050	1897.125	-050
1903.125	+050	1909.125	-050	1915.125	+050
1921.125	-050	1927.125	+050	1933.125	-050
1939.125	+050	1945.125	-050	1951.125	+050
1957.125	-050	1963.125	+050	1969.125	-050

TOP AND BOTTOM TURNING POINTS OF THE 13.50 YEAR WAVE

1850.125	+005	1854.125	-023	1860.875	+023
1867.625	-023	1874.375	+023	1881.125	-023
1887.875	+023	1894.625	-023	1901.375	+023
1908.125	-023	1914.875	+023	1921.625	-023
1928.375	+023	1935.125	-023	1941.875	+023
1948.625	-023	1955.375	+023	1962.125	-023
1968.875	+023				

TOP AND BOTTOM TURNING POINTS OF THE 16.00 YEAR WAVE

1850.375	+065	1858.375	-065	1866.375	+065
1874.375	-065	1882.375	+065	1890.375	-065
1898.375	+065	1906.375	-065	1914.375	+065
1922.375	-065	1930.375	+065	1938.375	-065
1946.375	+065	1954.375	-065	1962.375	+065
1970.375	-065				

TOP AND BOTTOM TURNING POINTS OF THE 18.30 YEAR WAVE

1851.625	+100	1859.125	-100	1869.875	+100
1877.375	-100	1888.125	+100	1895.875	-100
1906.625	+100	1914.125	-100	1924.875	+100
1932.375	-100	1943.125	+100	1950.625	-100
1961.375	+100	1968.875	-100		

TOP AND BOTTOM TURNING POINTS OF THE 19.50 YEAR WAVE

1854.125	+050	1863.875	-050	1873.625	+050
1883.375	-050	1893.125	+050	1902.875	-050
1912.625	+050	1922.375	-050	1932.125	+050
1941.875	-050	1951.625	+050	1961.375	-050
1971.125	+050				

TOP AND BOTTOM TURNING POINTS OF THE 23.25 YEAR WAVE

1850.125	-016	1857.875	+037	1869.375	-037
1881.125	+037	1892.625	-037	1904.375	+037
1915.875	-037	1927.625	+037	1939.125	-037
1950.875	+037	1962.375	-037	1972.125	+029

TOP AND BOTTOM TURNING POINTS OF THE 30.00 YEAR WAVE

1851.875	-040	1866.875	+040	1881.875	-040
1896.875	+040	1911.875	-040	1926.875	+040
1941.875	-040	1956.875	+040	1971.875	-040

TOP AND BOTTOM TURNING POINTS OF THE 37.50 YEAR WAVE

1850.125	+031	1868.125	-031	1886.625	+031
1905.625	-031	1924.125	+031	1943.125	-031
1961.375	+031	1972.125	-003		

TOP AND BOTTOM TURNING POINTS OF THE 51.50 YEAR WAVE

1850.125	-053	1873.875	+060	1899.375	-060
1925.375	+060	1951.125	-060	1972.125	+041

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  Allis-Chalmers Manufacturing Company
  Armour and Company
  General Electric Company
  Republic Steel Corporation
  Sears, Roebuck and Company
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